Standards in Process: Foundations and Profiles of ISDN and OSI Studies

D.M. Cerni

U.S. DEPARTMENT OF COMMERCE
Malcolm Baldrige, Secretary

David J. Markey, Assistant Secretary
for Communications and Information

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PREFACE

The convergence of telecommunication and computer technologies is demanding increasingly close cooperation among organizations responsible for standardization within the formerly distinct industries. This report was written to encourage and facilitate such cooperation by describing the historical background, objectives, structure, and work methods of U.S. and international organizations currently involved in computer communication standardization - specifically, development of the Integrated Services Digital Network (ISDN) and Open Systems Interconnection (OSI) standards families. The report is designed to provide coordinated answers to a broad spectrum of questions posed to staff members of the National Telecommunications and Information Administration's Institute for Telecommunication Sciences in conjunction with their standards responsibilities.

Many individuals outside ITS contributed to the development of this report by providing factual information and insights on the standardization process. Information interviews with the following U.S. standardization experts were of particular value: Elizabeth Bridgman (ANSI), Sophie Chuman (NBS/OPSP), George Codding (University of Colorado, Boulder), Kathleen Dally (OMNICOM), Dorothy Hogan (ANSI), Hal Folts (OMNICOM), Mary Ann Gray (IBM), John Haeffner (NBS/ICST), Bruce Johnson (Rixon), Catherine Kachurik (CBEMA), Peg Kay (NBS/ICST), Edward Lohse (Burroughs Corp.), Donald Mackay (NBS/OPSP), Eric Scace (GTE-BCS), Frances Schrotter (ANSI), Marty Weik (Naval Research Lab), and George White (NCS). Teresa Shanahan, GTE-Telenet, served as a technical reviewer of the draft manuscript. Bruce Johnson, Ed Lohse, and Donald Mackay also provided constructive comments on the draft. (Organizational affiliations indicated are those existing at the time of the interviews.)

The report also benefitted from the contributions of many ITS staff members. Thijs de Haas, Christine Hemrick, Joseph Hull, Neal Seitz, and William Utlaut shared their expertise in many informative discussions. Neal Seitz offered supportive direction and continual interest in all phases of the report development. Christine Hemrick and Joseph Hull served as technical reviewers of the draft manuscript. Evie Gray provided a format review and did a score of emergency tasks. Carole Ax and Cathy Edgar did magic with the word processor. Rex Powell carefully executed the figures. To each of these, the author says thanks.

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LIST OF ACRONYMS USED IN THIS REPORT

A

ADP	Automatic Data Processing
ANS	American National Standard
ANSC	American National Standards Committee
ANSI	American National Standards Institute
ARPANET	Advanced Research Project Agency Network
ASC	Accredited Standards Committee
ASME	American Society for Mechanical Engineers
ASTM	American Society for Testing and Materials
AT&T	American Telephone and Telegraph

B

BOC	Bell Operating Company
BSR	Board of Standards Review

C

CBEMA	Computers and Business Equipment Manufacturer's Association
CBX	Computerized Branch Exchange
CCB	Common Carrier Bureau
CCIR	International Radio Consultative Committee
CCITT	International Telegraph and Telephone Consultative Committee
CCST	Coordinating Committee on Telecommunication Standards
CEN	European Committee for Standardization
CEPT	European Conference of Postal and Telecommunications Administrations
CPE	Customer Premises Equipment
CPSC	Consumer Product Safety Commission
CSO	Central Services Organization

D

DCE	Data Circuit Terminating Equipment
DIS	Draft International Standard
DOC	Department of Commerce
DOD	Department of Defense
DP	Draft Proposal
DTE	Data Terminal Equipment

E

ECA	Exchange Carriers Association
ECMA	European Computer Manufacturers Association
ECSA	Exchange Carriers Standards Association
EEC	European Economic Community
EESB	Electrical and Electronics Standards Board
EIA	Electronics Industries Association

F

FCC	Federal Communications Commission
FDA	Food and Drug Administration
FIPS	Federal Information Processing Standards

F (cont'd)

FIPS PUBS	Federal Information Processing Standards Publications
FTC	Federal Trade Commission
FTS	Federal Telecommunication Standard
FTSC	Federal Telecommunication Standards Committee
FTSP	Federal Telecommunication Standards Program
FY	Fiscal Year

G

GATT	General Agreement on Tariffs and Trade
GNP	Gross National Product
GSA	General Services Administration
GSI	Special Group on the ISDN (CEPT)
GTE	General Telephone and Electronics Corporation

H

HDLC	High Level Data Link Control

I

IAC	International Advisory Committee
IAPP	Industrial Automation Planning Panel
ICSP	Interagency Committee on Standards Policy
ICST	Institute for Computer Sciences and Technology
IDN	Integrated Digital Network
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronic Engineers
IFAC	Industry Functional Advisory Committee
IFRB	International Frequency Registration Board
IR	International Representative
IS	International Standard
ISDN	Integrated Services Digital Network
ISO	International Organization for Standardization
ISONET	ISO Information Network
ISSB	Information Systems Standards Board
ITA	International Trade Association
ITS	Institute for Telecommunication Sciences
ITU	International Telecommunication Union

J

JTSCC	Joint Telecommunications Standards Coordinating Committee
JWP	Joint Working Party

K

Kb/s	Kilobits Per Second

L

LAN	Local Area Network

M

Mb/s	Megabits Per Second
MTN	Multinational Trade Negotiations

N

NBS	National Bureau of Standards
NCS	National Communications System
NCSCI	National Center for Standards and Certification Information
NOI	Notice of Inquiry
NPS	National Policy on Standards (for the United States)
NSPAC	National Standards Policy Advisory Committee
NTIA	National Telecommunications and Information Administration
NWI	New Work Item

O

OA&M	Operations, Administration, and Maintenance
OECD	Organization for Economic Cooperation and Development
OMB	Office of Management and Budget
OPSP	Office of Product Standards Policy
OSHA	Occupational Safety and Health Administration
OSI	Open Systems Interconnection

P

PABX	Private Automatic Branch Exchange
PASC	Pacific Area Standards Congress
PBX	Private Branch Exchange
PDN	Public Data Network
PL	Public Law
PSTN	Public Switched Telephone Network
PTT	Postal, Telegraph, and Telephone (Administration)

R

RPOA	Recognized Private Operating Agency

S

SC	Subcommittee
SG	Study Group
SIO	Scientific or Industrial Organization
SMC	Standards Management Council
SOR	Statement of Requirement
SPARC	Standards Planning and Requirements Council

T

TAG	Technical Advisory Group
TC	Technical Committee
TG	Task Group
TSC	Technical Subcommittee

U

USITA	United States Independent Telephone Association (now USTA)
USNC	United States National Committee
USTSA	United States Telecom Suppliers Association
USTTI	United States Telecommunication Training Institute

W

WG	Working Group

STANDARDS IN PROCESS: FOUNDATIONS AND PROFILES OF ISDN AND OSI STUDIES

D. M. Cerni*

Telecommunication and computer technologies are merging, stimulating such global communication projects as the Integrated Services Digital Network (ISDN) and the Open Systems Interconnection (OSI) Reference Model. The systems of standards needed to ensure worldwide success of these projects are being developed. These efforts, of unprecedented complexity, are demanding an increase in knowledgeable, dedicated standards workers.

This report offers background material on the meaning, significance, and changing nature of standards and their development, both in the United States and internationally. The importance of international standardization to U.S industry is stressed. Building on this foundation, the ISDN and OSI standardization efforts are presented as the consequences of converging technological advances worldwide. The increased cooperation among standards organizations such as the International Organization for Standardization (ISO) and the International Telegraph and Telephone Consultative Committee (CCITT) is documented. The report concludes with a summary of responsibilities and desired characteristics of standards writers.

Key words: American National Standards; ANSI; CCITT; computer standards; FCC; GATT Standards Code; IEC; international standards; ISDN; ISO; OSI Reference Model; regulations; Study Group XVIII; ASC T1; TC97; telecommunication standards; voluntary standards; ASC X3

1. INTRODUCTION

In 1876, the year following the successful introduction of the telephone in the United States, Alexander G. Bell purportedly offered to sell his telephone patents to Western Union Telegraph Company. William Orton, Western Union president, refused Bell's offer apparently because at that time he shared the common view that the telephone was a toy not to be taken seriously. A journal of the day expressed this widely held opinion:

The telephone is a scientific toy, interesting of course, but it can never be a practical necessity (Trade Journal, 1877).

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*The author is with the Institute for Telecommunication Sciences, National Telecommunications and Information Administration, U.S. Department of Commerce, Boulder, CO 80303.

Seldom has a prediction been more inaccurate. By 1975, one century later, telecommunications, largely the telephone, had become as essential to the business infrastructure as good highways and ubiquitous airline routes. A telephone company, AT&T, had become the largest business organization in world history.

In spite of its steady growth, telephony, in its first century (i.e., 1876-1975), "was a sleepy, provincial business" (Business Week, 1983). Now, less than one decade later, telecommunications has been referred to as a "global battle" and a "strategic weapon" (Business Week, 1983) and has even been discussed as a "battlefield" (Schiller, 1983).

What happened in the past decade to move telecommunications from a "sleepy business" to the most innovative, controversial, and probably most challenging business worldwide, accounting for 9% of the U.S. gross national product? The answer can be found in the introduction of the digital computer into the infrastructure of business, and into telecommunication networks themselves--the so-called marriage of computers and telecommunications. To paraphrase a current T.V. slogan, the merger of computers and telecommunications has "changed the way America talks." In particular, as computers that talk to each other by means of telecommunications invade the business world:

> . . . telecommunications becomes an important strategic weapon to all companies. Instead of needing communications systems to transmit phone calls and telex messages, companies must now have them for such tasks as sending huge volumes of computer data at high speeds, transmitting facsimiles of blueprints, and holding video conferences (Business Week, 1983).

1.1 Background

Paradoxically, the digital communication techniques that underlie modern computer communications and have become essential to modern telephony are derived from telegraphy and predate analog telephony. The early (1832) use of discrete, coded electric information signals (i.e., digital signals) to transmit information in the Morse telegraph marked the beginning of digital communications. Figure 1 (Astrain, 1983) illustrates the increasing transmission capability of digital communication equipment from the telegraph of the early 1800's to the advanced optical fiber that is being developed for future use. Although the increasing capacity available from digital technology has consistently outpaced the service demand, Figure 1 indicates

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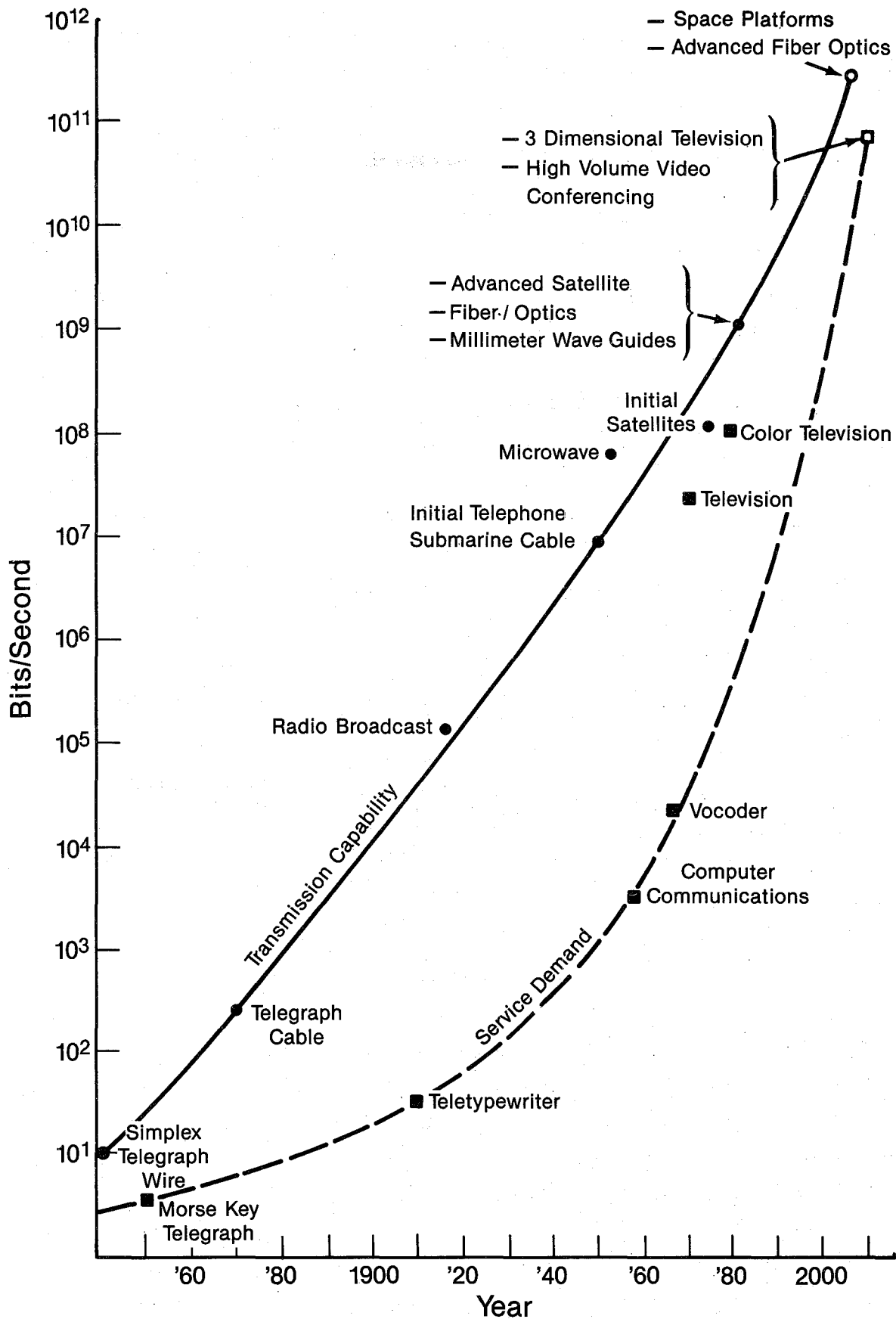
Figure 1. The development of digital telecommunications (service demand vs. transmission capability) through the year 2010.

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that the gap between technical potential and the service demand is closing. At the same time, the cost of digital transmission is rapidly decreasing.

1.1.1 The U.S. Position in Telecommunications

The United States is still the leader in many areas of technical innovation and trade in what the world believes are the critical industries for future growth: telecommunications, computers, and information processing, as well as the services that grow out of or depend upon these technologies. There are, however, continuing pressures from our allies and other trading partners to close the gap. The import/export markets are in constant flux and uncertainty as the world becomes one huge, highly competitive marketplace.

1.1.2 The Information Age

The intense competition is not directed solely to equipment and networks-in-place, but is keenly concerned with information as a resource. Information's production, storage, and rights of transfer have given a new meaning to the expression "knowledge is power." The very term "Information Age" reflects the fact that "the main activity of advanced industrial societies is increasingly involved in the production and distribution of information" (Dizard, 1982).

The following dramatic yet insightful statement sums up the importance of information control:

> . . . let there be no mistake--telematics is today a battlefield upon which the underlying shapes and imperatives of the entire world economy are being contested. Final results of the international information war are unpredictable, even unforeseeable. Yet, its implications are starkly clear. Whoever controls the equipment, markets, the software, and services that are telematics stands to benefit from an unprecedented centralization of control over global economic activities and resources (Schiller, 1983).

1.2 Purpose and Scope of Report

The main purpose of this report is to address a fundamental aspect of the worldwide digital revolution--the need for universally accepted standards and compatible transmission techniques to achieve effective interconnection of digital communication systems. Two global efforts are well underway: the Integrated Services Digital Network (ISDN) and the Open Systems Interconnection (OSI) Reference Model. This report provides material on

standards and standardization, both domestic and international, as background for the discussions on the ISDN (Section 8) and OSI (Section 9).

The material included in this report was chosen to give a comprehensive overview of standards development. Topics considered peripheral to this purpose are not discussed (e.g., computer markets or the New World Information and Communications Order). A conscientious effort has been made to be as accurate and up-to-date as possible in the report content. However, because of the complexity of the subject matter and the fast pace of change within standards organizations, the reader is encouraged to contact any organization of particular interest for more specific detailed information. Certain flexible details, such as standards-committee structure and chairmen, are included to provide a snapshot of a dynamic process.

The demand for standards, and therefore for writers of standards, is increasing daily. This report is directed mainly to the industrial or Governmental worker and/or user interested in participating in standards development—and to the managerial and supervisory personnel responsible for funding that participation. To the author's knowledge, this is the first substantial study of standards-related activities addressed to potential standards writers.

The relevance of this report is not limited to new standards writers nor to their managers. For the experienced participant in standards work, the report offers details on standards organizations, both domestic and international, that may now become increasingly relevant to him or her as the work of heretofore separate organizations converges. As standards increase in importance to all of us, the process of their development becomes increasingly significant as well. In the words of Mr. Henri-Durand (1981), then President of ISO: "The esoteric concept of a standards discipline solely of interest to specialists is outdated, and must be buried. By the end of this century every person should feel himself or herself involved".

1.3 Structure of Report

The scope of this report is extensive. The following section summaries indicate the major topics covered within each section. Although the report has been written to be read sequentially, the reader may choose to skip introductory sections containing familiar material. Cross-referencing between sections is common but each section is intended to be self-contained.

As an aid to the reader in following the numerous acronyms used in this report, a list of acronyms has been provided on pages xi, ff.

1.3.1 Section 2: Standards and Standardization: an Overview

Section 2 provides a general summary of the meaning of standards and the processes by which standards are developed. Special emphasis is placed on documentary standards--basic, product, and system standards. Standardization (a billion-dollar industry in the United States) is depicted as a systematic discipline. Possible economic benefits accruing to the standards developer are indicated.

1.3.2 Section 3: The Evolution of U.S. Standardization Activity

This section offers an historical background of U.S. standardization activity from 1850 to the present. This activity has been divided into five periods: The Beginnings (1850-1918); The "Crusade for Standardization" (1919-1946); Post World War II Expansion (1947-1970); Attempts to Regulate Voluntary Standards (1971-1982); and The United States and International Standards (1980-?). Section 3 concludes with some reflections on the future of U.S. standards development.

1.3.3 Section 4: Development and Use of U.S. Standards and Regulations

Section 4 contains summaries of the U.S. voluntary standards system, the U.S. regulatory system, and the relationship between the two. The Federal Communications Commission (FCC) is discussed as an independent regulatory agency. Its role in the recent de-regulation of the telephone industry and its interest in ISDN are summarized.

The decade of the 70's was rife with efforts by various groups within the Federal Government to regulate standards activity. These activities are discussed.

Two types of standards developed by Federal Government agencies (and often mandatory for use by Government agencies) are explained: the Federal Information Processing Standards (FIPS), and the Federal Telecommunication Standards (FTS).

1.3.4 Section 5: ANSI's Role in the U.S. Voluntary Consensus System

Although the American National Standards Institute (ANSI) does not develop standards, it does play a critical role in the approval of standards

as American National Standards. ANSI's organization and its roles as approver of American National Standards and coordinator of the accreditation process are presented. Two Accredited Standards Committees (ASCs) that follow ANSI's guidelines are detailed: X3, "Information Processing Systems," and the recently formed T1, "Telecommunications."

1.3.5 Section 6: The Significance of International Standards

Section 6 presents an overview of the changing nature of international standards, the importance of international standards to international trade, and the significance of the developing countries' involvement in international standardization. The effects of the Information Age on international standardization are summarized.

1.3.6 Section 7: International Standards Organizations and Standards Development

This section describes the general background, organization, and working methods of three major international standards organizations: the International Organization for Standardization (ISO), the International Electrotechnical Commission (IEC), and the International Telegraph and Telephone Consultative Committee (CCITT). The role of ANSI as the official U.S. representative to ISO and IEC is discussed and the relationship of the ANSI-related U.S. Accredited Standards Committee X3 (ASC X3) to ISO Technical Committee 97 (TC97) is explained.

1.3.7 Section 8: The ISDN and Worldwide Standardization Efforts

The standards work on the ISDN was initiated by, and the international effort is centralized in, the CCITT. Section 8 summarizes the historical background of this CCITT effort, the on-going work on ISDN standardization, and the importance of U.S. participation in these studies. Directions of ISDN standardization efforts and the work of other organizations involved in these studies are indicated.

1.3.8 Section 9: The OSI Reference Model and Worldwide Standardization Efforts

The OSI Reference Model has its 1977 origins in the ISO, and continual ISO/CCITT coordination efforts have resulted in two identical (for all practical purposes) international standards: the 1983-approved International

Standard ISO 7498, "The Open Systems Interconnection Reference Model," and the 1984 CCITT Recommendation X.200, "Reference Model of Open Systems Interconnection for CCITT Applications." Section 9 offers the background of these OSI studies, an overview of the ongoing development of the international interface and protocol standards built on the OSI Reference Model framework, and a summary of U.S. efforts on OSI-related standards.

1.3.9 Section 10: The Standards Writer

One significant conclusion drawn from the first nine sections of this report is that the standards writer is a major determinant of good standards development. Section 10 summarizes the demands made on the standards writer in terms of time, commitment, continuity, and funding, and tabulates the characteristics ideally possessed by the writer.

2. STANDARDS AND STANDARDIZATION: AN OVERVIEW

The term "standards" suffers from centuries of use and misuse. The meaning of the term can be vague and amorphous, even though standards have become an essential, all-pervasive element of modern society from the cars we buy to the wax we use to shine the cars. Not only is the term used in a variety of contexts (e.g., various industries, economics, medicine, law) with different connotations, but the voluntary and/or regulatory aspects of standards are often misunderstood and misconstrued.

For the short- and long-term benefits of standards to be appreciated by an individual--whether a consumer, manufacturer, or provider--a general understanding of the importance of standards in society, including the roles standards play in domestic and international markets, is necessary. The lack of such understanding may cloud the perceived significance of standardization activities. Only clearly perceived benefits of standardization will encourage industry, government, or users to pay the costs, both financial and personal, that are ultimately associated with standards development.

Section 2 attempts to clarify, in a general way, the meaning, nature, role, significance, advantages, and potential disadvantages of standards, as well as the meaning and importance of the discipline of standardization. These concepts are all developed more fully in later sections of the report.

2.1 The Meaning of Standards

The following informal, tongue-in-cheek definition of standards captures the essence: "Standards are written as communication media to avoid reinventing the wheel" (MacDonald, 1981). Standards generally describe, define, or document an already existing reality (or problem solution) so that others can easily reproduce this reality (or solve a similar problem), thereby avoiding a duplication of effort. The need for standards evolves as society becomes more complex, forcing cooperative attempts to make the best use of limited resources. The information revolution, new applications of technology, improved communications worldwide, personal and societal requests for new products and services, and economic advances of developing countries all demand standards and are thus fueling cooperative ventures for standards development. Industries, especially computer industries, fear that if they ignore or are not involved in the present standardization efforts, they, in turn, will be bypassed by future markets. Standardization is a continuously evolving process.

The three general classifications of standards are object standards, documentary standards, and conceptual standards. Object standards, established with the help of a physical object or defined in terms of natural phenomena, include those used as reference for mass, length, and time. The object standard is the most resistant to change, although the object of measurement can be replaced by another (e.g., metal-bar meters by wavelengths). Documentary written standards, by far the most common form of standards, range from a sentence to several hundred pages and may include definitions, diagrams, classifications, recommended practices, specifications, test methods, codes, etc. These standards are far from static. The third class of standards, conceptual standards, are more abstract in nature and encompass customs and traditions. Even if eventually written down, and then carefully documented, conceptual standards still remain conceptual in nature. Examples of conceptual standards are the personal and social behavioral standards documented by such writers as Emily Post.

In this report, the word "standard" is used to mean "documentary written standard." Although there is no one widely accepted and quoted definition of such a standard, the following definition from the 1979 National Policy on Standards for the United States (NPS) encompasses the essential concept:

> A standard is a prescribed set of rules, conditions, or requirements concerning definition of terms; classification of

components; specifications of materials, performance, or operations; delineation of procedures; or measurement of quantity and quality in describing materials, products, systems, services, or practices (NPS, 1979).

This definition confines its scope to the particular aspects that may be found within a documentary standard. The following definition is offered for comparison purposes. This one attempts to include statements of development, approval, purpose, and implementation.

[A Standard is] a technical specification or other document, available to the public, drawn up with the cooperation and consensus or general approval of all interests affected by it, based on the consolidated results of science, technology, and experience, aimed at the promotion of optimum community benefits, and approved by a body recognized in the national, regional, or international level (Kemmler, 1983).

Within the extensive world of standards (the National Bureau of Standards [NBS] lists over 240,000--see Section 4.3.3) are standards with differing status, depending upon their sphere of applicability. These status levels, forming a hierarchy, are company, industry, interindustry, national, Government (regulating), regional, and international.

In the United States, most commercial standards are termed "voluntary" for reasons discussed in Section 4.1. Exceptions to this are 1) those relating to safety and health or to environmental issues, called Government regulations (see Section 4.2), and 2) those used by Government in its business activities, often mandatory for use by Government agencies (see Section 4.4). This report stresses the development of U.S. voluntary standards and the differences between national (voluntary) standards and Government regulations, as well as the development of international standards and their role in furthering the growth of international trade.

There are several terms closely associated with standards--code, certification, and accreditation. Often, especially in Government and international documents, these concepts are included in the basic term, "standards." There are no uniform definitions or uses of these words, as there are not for standards themselves. Historically, and even today, these words--code, certification, and accreditation--have had different connotations depending upon the application and/or the person using them. The following definitions are offered here because these terms are used--sparingly-- elsewhere in this report.

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A _code_ is a systematic collection of standards or regulations, relating to a particular subject, having statutory force.

Certification is an action taken by a legally responsible party to attest that a product conforms to relevant standards. It also refers to the process by which a testing agency verifies and reports a product's conformance. Whatever the form of certification, "it provides assurances to the purchaser that a product has been tested and found to possess the characteristics addressed in the relevant standard(s)" (FTC, 1983).

Accreditation is the act or process by which a standards organization is approved for standards development by the higher body or organization having responsibility for the standards.

2.1.1 Basic, Product, and "Integrated Systems" Standards

Of the various types of documentary standards, three will be referred to several times in this report, particularly in connection with international standards efforts. The first is the basic, or the fundamental standard, referring to those standards that establish basic principles for any industrial development. These include standards that document, for example, units for measurement and reference, technical drawings, and precision of test methods. These basic standards are universally applicable, no matter where an individual standard may originate or what level of technology exists in the country of application.

The second type of standard is called the product standard, especially as it addresses performance and output requirements relating to actual product use such as strength, conductivity, and efficiency. The product standard is primarily an external standard. Although formerly the domain of national standards groups, international groups are increasingly involved in this work. Section 6.1 discusses some reasons for this shift. Product standardization is not an aim in itself, and ISO and IEC have prepared a joint statement that defines the limits of international product standards, while recognizing that different fields require different approaches. The statement includes general principles to be considered in assessing the need for the standard and guidelines for the technical content. A summary of the 1981 ISO/IEC statement is provided in Appendix A.

The third type of standard is the "integrated systems" standard, born of two recent phenomena: the need to match newly developed "high technology" with newly developed frameworks in which individual standards development efforts can be planned and developed within a total system, and the overlapping of technologies formerly perceived as separate.

The integrated systems approach to standards not only helps establish a standards direction that is consistent with the overall objectives of an industry, but allows for multiple development efforts to be integrated into a cohesive structure. A total system understanding ensures the practicality and feasibility of a particular standard, determines that a standard from one part of the system does not have a detrimental effect on an other segment of the system, helps ensure that restrictions are not put on internal systems design options, and helps avoid inhibitions to innovation.

Technology integration has influenced standardization by forcing standards writers from different disciplines to work in close coordination. The two examples developed in this report--OSI and ISDN--are worldwide integrated efforts, both involved in the merging technologies of telecommunications and computers. Sections 8 and 9 deal with the intensive coordination required among different standards organizations to succeed in these highly complex standardization efforts.

2.1.2 The Advantages and Disadvantages of Standards

Standards, originally designed to ensure industrial mass production, now play many other beneficial roles as well. While the average consumer may relate "standard" to strict physical measurement, and/or associate regulatory control with standards development and implementation, there is evidence of growing worldwide recognition of the need to broaden the concept and scope of standards.

The traditionally accepted advantages of standards include their potential a) to increase productivity and efficiency in industry because of larger scale, low-cost production of interchangeable, uniform parts; b) to foster competition by allowing smaller firms to market products, readily acceptable by the consumer, without the need for a massive advertising budget; c) to disseminate information and provide technology transfer; d) to expand international trade because of the feasible exchange of products among countries; e) to conserve resources; and f) to improve health and safety. In addition, one inherent advantage of standards relating to communications is the increasing opportunity for worldwide exchange of information, both voice and data. The very process of standardization also provides benefits to the participants, including the exchange of state-of-the-art information.

Some functional roles of standards are described here. For industry, standards constitute a vast store of expert technological information that may

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serve as the basis for innovation and new market products. In the traditional mode, widespread implementation of standards permits quality control and product integrity, reduces costs through economies of scale, and simplifies inventories because of interchangeability of parts. In a world where business depends on telecommunications, standards today permit worldwide voice connectivity and, increasingly, computer connectivity.

For those concerned with safety and health, standards help set minimum and maximum requirements. The ordinary citizen is protected by an ever increasing (although always controversial) set of environmental regulatory standards designed to protect our waterways, earth, and air. User organizations are able to use standards to set performance criteria, even in advance of available technology.

International harmonization of national standards can facilitate world trade, world travel, and good will among nations. The U.S. Government, for example, can and does use standards to promote efficiency in procurement, to help transfer technology to developing countries, and to provide a system of personnel qualifications, such as in the trades (Williams, 1981).

Not all members of industry view standards as beneficial to business. Those who wish to promote proprietary systems that preclude customers from buying competitive products might view industry-accepted standards as undesirable. Possible disadvantages of widely implemented standards are their potential to inhibit innovation and/or other (perhaps superior) solutions, and their potential to limit the choices available to the consumer for the specific product or service. These aspects are of special concern today in the telecommunication and computer fields because the trend is to develop standards (especially on the international level) prior to widespread implementation or experimentation (see Section 6.2). Standards developers attempt to minimize the negative aspects by keeping new standards directed toward performance (not design) specifications and definitions.

Standards must be developed with proper concern for the widely accepted procedures for this activity (see, particularly, Sections 2.2, 4.1, and 7). Standards that are developed outside of these procedures can actually suppress free and fair trade, impede technical progress, and adversely affect trade, commerce, health, or safety. Widespread, active concern about these potentially negative consequences of standards and standardization has been expressed in the past decade in and out of Government, nationally and internationally. Sections 4.3 and 6.3.3 summarize these activities and

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present the resultant documents that help guide standards work in the United States today.

2.2 The Meaning of Standardization

Although less than a century old when considered as an institution, standardization--the process of standards development--has evolved into a complex, sophisticated activity that can be considered both a discipline and an industry. This is illustrated by the fact that just two of the more than 400 U.S. voluntary standards organization--the American Society for Testing and Materials (ASTM) and the American Society for Mechanical Engineers (ASME)--involve more than 100,000 persons in the writing of standards. The total yearly cost for standards development in the United States is now well over $1 billion. For the standards organizations, national and international, proceeds from selling published standards often reach several million dollars.

2.2.1 Standardization as a Discipline

Standardization activities can be viewed from two interrelated vantage points, technical and organizational. In actual practice, the technical content of a far-reaching standard, no matter how exact and good it is, has little chance for acceptance if the developmental process through which it was formed is not clearly approved and accepted by the relevant national or international standards community, as the case might be. In general, this report does not consider the technical content of specific standards, but stresses the organizational modes of development. Exceptions to this are found in the ISDN and ISO discussions in Sections 8 and 9 in which some technical concerns are presented.

Standardization has been defined by ASTM as the process of formulating and applying rules for an orderly approach to a specific activity for the benefit and with the cooperation of all concerned. It is based on the consolidated results of science, technique, and experience. It determines the basis not only for the present, but also for future development and it should keep pace with progress. The standardization technique, the set system of rules by which standards are developed, has evolved over a century and can now be considered a discipline in its own right, to be adhered to by participants, and to be studied and learned by newcomers.

The nature of standardization is to arrive at an integrated, agreed-upon solution, and it demands that attention be focused on each possible aspect of a given situation as well as on the possible effects of this solution on other established standards. In addition, according to the directions contained in a recent Office of Management and Budget (OMB) circular (see Section 4.3.1), in the United States "full account shall be taken of the impact on the economy, applicable Federal laws, policies, and national objectives, including, for example, laws and regulations relating to antitrust, national security, small business, product safety, environment, technological development, and conflicts of interest" (Federal Register, 1982). As such, the systematic, interrelated cooperative approach to standards writing "pervades all walks of life and touches upon all other disciplines by furnishing, so to speak, an infrastructure for their operation and regulation" (Verman and Visvesvaraya, 1977).

The interrelationship of the standardization "system" with other systems is presented in Figure 2 (after Verman and Visvesvaraya, 1977). Standardization may be looked upon as a system of systems, the actual interactions of which depend upon the circumstances. However, the potential complexity of the process should not be taken to mean the fixing of a particular design or parameter forever, but usually means the adoption of a standard subject to a regular organized process of review and reconsideration. A 5-year review cycle is typical.

The organizational structure or technique of standards development, with an emphasis on telecommunication and information processing standardization, is the main thrust of this report. Standardization is viewed as a process of several stages: standards project initiation, group development, formalization, acceptance for potential use, and implementation. The discussions of these stages include the "why," the "who," and the "how" of standardization.

2.2.2 The Economic Benefits of Standardization

Because standardization has become recognized as a discipline and an industry in itself, standardizers and economists have begun to research ways to quantify its effects. The difficulty of evaluating these effects is complicated by ever more complex economic structures worldwide. However, it is clear that this evaluation is considered significant as indicated in a recent ISO publication, "Benefits of Standardization" (ISO, 1982a).
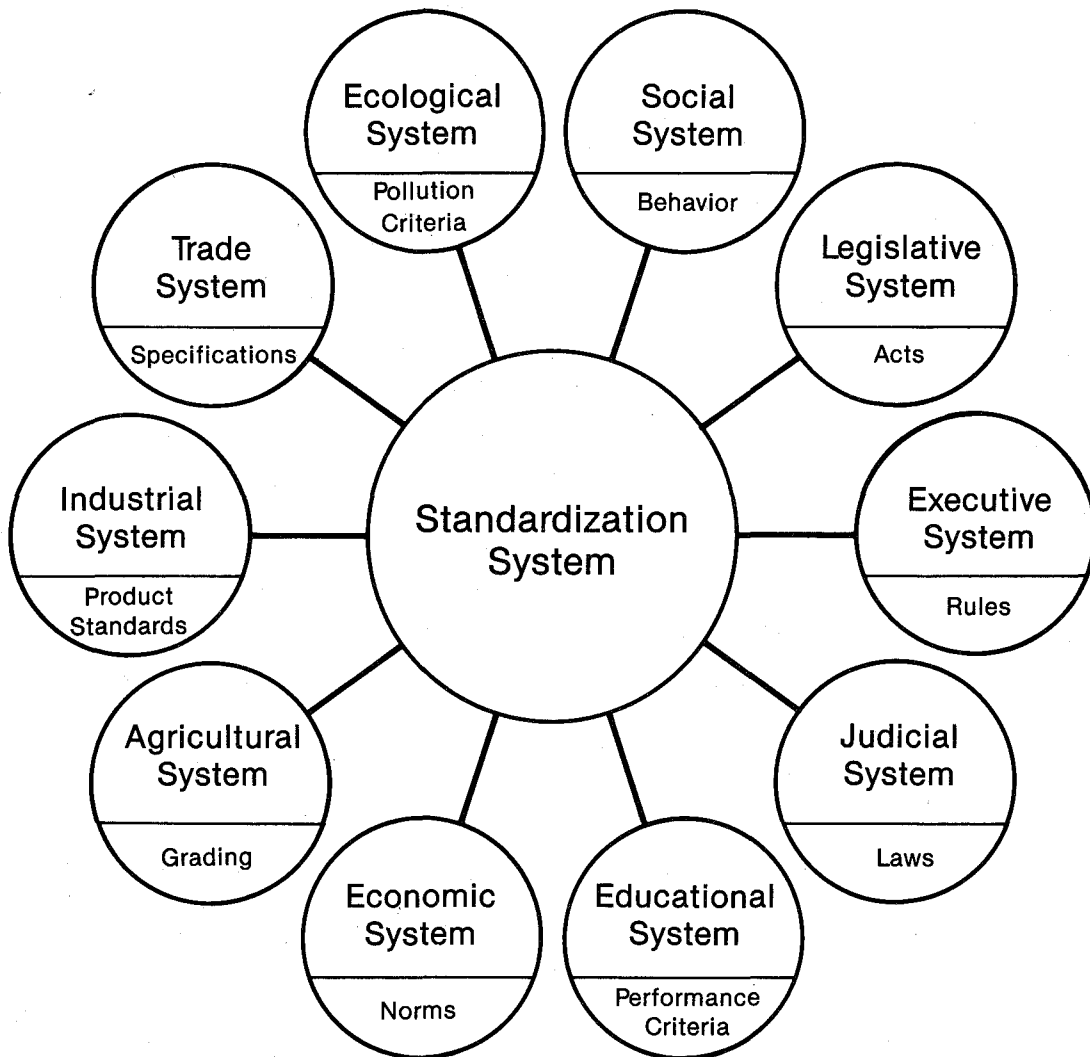
Figure 2. Interrelation of the standardization system with other
systems. Typical examples of standardization content
are given in the lower parts of the circles.

The 144-page ISO volume gives an overview of the present role and potential future roles of standardization, with particular emphasis on the economic effects and existing fields of application that are expected to expand enormously in the future. The study gives the "industrialist working at the company level and the expert working at the national or international levels a better grasp of the many aspects of the benefits of standardization—benefits affecting not only technology and the community but also communication and understanding among nations" (ISO, 1982a).

One topic discussed, for example, is the profitability of standardization activity. This is of interest on all levels from the company standards office to the international standardizing bodies. Using the definition for rate of return of a standardization activity as "the ratio of total annual revenues from all standards in operation during a specified year, to the total standardization cost (including running costs) for the same year" (ISO, 1982a), extensive data were collected. Table 1 represents typical (hypothetical) data. The revenue information is related to the original year of issue for each standard. The table shows the total of the revenues from standards with the same year of issue.

Figure 3 is a graphical representation of these data at the company level. The gradual reduction in the added revenue each year depends on the increase in the annual running costs, which must cover the increasing number of standards. The annual revenues will gradually approach a probable standardization ceiling above which no further increase will be possible without increasing the overall standardization costs. (This ceiling should coincide with a target visualized by the company.) As a rule, similar characteristics are observed at the national level.

In the preface to the ISO book, "Benefits of Standardization," the point is clearly made that the title is not meant to convey the impression that there are no disadvantages to the process. It is partly because standardization has inherent disadvantages that it must be taken quite seriously.

3. THE EVOLUTION OF U.S. STANDARDIZATION ACTIVITY

Standards are at least as old as civilization. A cylindrical royal Egyptian stone, a standard object, was used as a unit of measure 9,000 years ago. In 1266, Henry III of England decreed that a penny was to weigh the equivalent of 32 grains of wheat "taken from the middle of the ear." By the

Table 1. Revenues Relative to Year of Issue
(Fictitious Example) (ISO, 1982 a)

Year of issue from start of standardization activity	Annual revenue from standards issued this year USD x 10^3*	Total annual revenue from standards issued up to and including this year USD x 10^3*
1	100	100
2	94	194
3	88	282
4	83	365
5	78	443
--	--	---
--	--	---
20	31	1183
21	29	1212
22	27	1239
23	25	1264
24	24	1288
25 *U.S. Dollars	23	1311

Figure 3. Graphical representations of data in Table 1.

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15th century, standardized mass production of Venetian galleys had developed. In the United States, standard-sized bricks were made mandatory in 1689 in Boston to aid in the rapid rebuilding of the Colonial City, destroyed by fire. In 1780, Eli Whitney, the "Father of Standardization," illustrated the advantage of mass production in the manufacture of muskets by using standardized parts.

From these early attempts, the discipline of standardization has developed into an international activity upon which the future of international trade, the interworking of "noncompatible" computers, and worldwide communications now depend.

The history of standards in the United States can be divided (with some overlap) into 5 periods, each shorter than the preceding. The decrease in duration reflects the accelerating technology recorded by the developed standards, as well as the increasing importance of the standards themselves. These 5 periods, described below, are:

1. The Beginnings: 1850-1918
2. The "Crusade for Standardization:" 1919-1946
3. Post World War II Expansion: 1947-1970
4. Attempts to Regulate Voluntary Standards: 1971-1982
5. The United States and International Standards: 1980-?

3.1 The Beginnings: 1850-1918

From the point of view of the United States, the modern age of standards began in the 19th century with the development of industrial mass production and the absolute need for interchangeability of parts. For example, there were at one time thousands of sizes of nuts, bolts, and screws, an intolerable inefficiency in an industrialized society.

During the latter half of the 19th century, urged on by problems encountered during the Civil War, industrial organizations emerged to resolve the incompatibility problems. As early as 1852, civil engineers had already united. In 1871, mining and metallurgical engineers were organized, and in the 1880's mechanical and electrical engineers followed suit. In 1898, a nonprofit organization called the American Society for Testing Materials (later called American Society for Testing and Materials--ASTM) was incorporated to create a technically neutral organization wherein "standards and their supporting documents could be objectively prepared, based upon recognized data, in a truly consensus mode" (Andrews, 1978). ASTM started to codify standard sizes and strengths, and to expand other characteristics for

the burgeoning steel industry. (ASTM is now the largest nongovernment standards-developing organization in the world. It has developed and now maintains more than 6500 consensus standards.)

By 1900, it was widely accepted that standardized products were a must and that standardized materials for these products were prerequisite to achieving economies of scale. As the need for standards outstripped the facilities to provide them, the National Academy of Sciences pressed Congress to establish a national standardizing laboratory. In 1901, the National Bureau of Standards (NBS) was founded, modelled on similar organizations in Germany and England. In addition to taking over and expanding the Treasury Department's Office of Weights and Measures, NBS was given the responsibility of making tests to guide the purchases for Federal departments and thus became a technical resource for both Government and industry, researching and setting standards for a myriad of materials and products (including cement, light bulbs, paper, resins, etc.). By 1911, NBS was conducting 80,000 tests annually. (See Section 4.3.3 for further discussion on NBS.)

However, industry did not want all standards to become the province of a Federal agency, and even NBS officials agreed that such a mammoth task would subject them to unwanted political pressure. Although standards are a Government responsibility in almost all nations, this situation never came to pass in the United States even though it was advocated by some. The issue of the relationship of the U.S. Government to voluntary standards organizations in the standards process, however, has continuously surfaced during the past 70 years, reaching its peak in the late 1970's. This saga is dealt with in Section 4.

As the number of standards-related corporations, trade associations, and professional societies grew, both before and during World War I, overlap and inevitable conflict occurred. Independent development and issuance of standards by many different organizations resulted in standards that often duplicated or conflicted with each other. Often, specifications differed greatly for the same item.

Various Government boards became involved and brought some order to the system. Automobile tires, for example, were reduced from 287 types to 9. ANSI (then called the American Engineering Standards Committee) was founded in 1918 to further reduce the disorganization and resultant waste of resources in U.S. voluntary standards efforts. ANSI was not then, nor is it now, a

standards-developing organization. Rather, ANSI functions to coordinate and harmonize private sector standards developed elsewhere (see Section 5).

During this period, interest in international cooperation on electrical standards resulted in a number of international congresses held at the end of the 19th century and the beginning of the 20th. When the first of these congresses was held in 1881, there were, for example, 12 different units of electromotive force, 10 different units of electric current, and 15 different units of resistance. This first congress led to international agreement concerning the volt, the ampere, and the ohm, and the relationship among them (Ohm's Law). The 1904 congress, held in the United States, resulted in the formation of the International Electrotechnical Commission (IEC). Its principal objective is "to facilitate the coordination and unification of national electrotechnical standards." The IEC is discussed in Section 7.2.

3.2 The "Crusade for Standardization:" 1919-1946

In 1919, a growing sensitivity to the rights of workers was expressed in a drive for industrial safety codes. Building codes were developed, and standards were adopted for pharmaceuticals and agricultural products. Although the standards movement had been initiated by mass production, it now began its eventual introduction into every aspect of the American way of life.

During Herbert Hoover's term as Secretary of Commerce (1921-1928) the "Crusade for Standardization" became very popular. The crusade received its basic impetus from a survey report, "Waste in Industry." The report disclosed that more than 30% of the costs of production and distribution could be eliminated (without affecting wages and labor), and that $10 billion could be saved annually in only six industries, through standardization and simplification alone. With that knowledge "an all-out war on waste through the establishment of standards and related measures was begun as a cooperative Government-industry effort" (Forman, 1981).

Standards were written for specific products or for specific test methods as the need developed among the users or manufacturers of products. The concept of "consensus standard" was established, but "because there was no strong consumer interest or input in standards development, the need for rigorous observance of due process, and other principles of standards writing with which we are all familiar today was not expressed" (ASTM Standardization News, 1980).

World War II further focused the need for standards and standardization, especially on an international level. Allied troops found incompatibilities and inoperabilities in everything from gasoline pipe lines to radios, and most of the required standards were not the domain of any international group. As a result, an ad hoc standardization effort was begun, and this was upgraded in 1946 to the International Organization for Standardization (ISO) (see Section 7.1).

3.3 Post World War II Expansion: 1947-1970

The period of greatest increase in standards activity occurred immediately following World War II, when American industry was ushered into the nuclear age and a second industrial revolution. The trend toward standardization by private sector organizations grew. In 1951, Herbert Hoover, on the occasion of his acceptance of an award from the American Standards Association (now ANSI), summed up the thinking of the standards community in these words:

> Standards are at the base of all mass production . . . . They have sharpened competition . . . . They have cheapened the cost of production in millions of directions. Thus, they have been a factor in our rising living standards. They have enabled thousands of different articles to be placed within the reach of everybody. They do not impose uniformity on the individual because they make available to him an infinite variety of additions to his living (Forman, 1981).

Standardization made great strides in theory and in practice. This has been largely attributed to three factors. First, there was the rapid growth of technology. Second was the realization that the inherent applicability of the principles of standardization and the benefits to be derived from their adoption are not limited to engineering disciplines and industrial or commercial enterprises. They go far beyond these borders to cover all branches of human socio-economic activity, including agriculture, medicine, management, and education. The third factor, which has evolved into one of critical worldwide importance today, was the opening up of the world as a whole with a large number of new and independent nations coming into being, each aspiring to economic advancement. These factors contributed to unanticipated growth of international trade (both goods and services) and the evolution of international cooperation on economic and cultural fronts, including the escalating exchange of technology across national borders.

In terms of telecommunications alone, this was the time period that witnessed the first transatlantic submarine cable for telephone (1956), the first commercial satellite facilities between the United States and Europe (1965), the first U.S. data network (1965), and the first fully automatic telephone dialing (1970). United States revenue from international telecommunication services increased 800% from 1951 to 1970 (Cerni, 1982a). These developments caused the U.S. Government and the U.S. common carriers to have an increased interest in the U.N. specialized agency, the International Telecommunication Union (ITU) (see Section 7.3.1), founded in 1865 in Europe. This interest was centered chiefly in the two standards-developing ITU organizations, the International Telegraph and Telephone Consultative Committee (CCITT) and the International Radio Consultative Committee (CCIR). The general purpose of the CCITT, discussed in Section 7.3 of this report, is to promote and ensure international telecommunication interoperability. By 1970, the United States was viewing national and international standardization as significant activities to be factored into the success equation of any business.

3.4 Attempts to Regulate Voluntary Standards: 1971-1982

The years of U.S. experience in standards development had made it obvious to industry that the subject of standards deserved concentrated attention. A series of significant reports and books emanated from the private sector in the early 70's, and self-examination of the voluntary standards process was strong. Public awareness of and resultant consumer involvement in standards-related activities, although not so strong as today, were emerging.

Similarly, from the Government sector, an overall examination of the process of standardization in both private and public sectors was underway. In addition, several alleged "exclusionary standard" cases surfaced in the United States in the late 60's and early 70's (e.g., the Plywood Case, the Automatic Gas Vent Damper Case) that raised questions about the possibility of standards being used in ways that are contrary to the public interest (see Section 4.3.1).

A decade-long effort ensued—involving Government, industry, and voluntary standards-developing organizations—to determine the proper role of Government and its regulatory functions in the development of voluntary and mandatory standards. A partial list of reports, studies, and other actions,

from both the public and private sectors, is given in Table 2. Most of these actions are discussed in this report.

Two major documents have emerged from this period, each contributing to the establishment of U.S. ,policy regarding standards. Private sector initiative developed the 1979 "National Policy on Standards for the United States" (NPS, 1979); the public sector prepared the 1982 Office of Management and Budget (OMB) Circular A-119, "Federal Participation in the Development and Use of Voluntary Standards" (Federal Register, 1982). Both documents stress Government's role as an important and equal partner in the day-to-day activities of the U.S. voluntary standards system, affirming that the national interest is best served when both the public and private sectors cooperate in this activity. The present strength and continued growth of the voluntary system, including the position of the regulatory system vis-à-vis standards, are discussed in Section 4.

During the 70's, on the international level, standards were being intensely studied as potential technical barriers to trade, and this work resulted in the 1979 "Agreement on Technical Barriers to Trade," promulgated by the General Agreement on Tariffs and Trade (GATT). This "Standards Code," as it is known, attempts to eliminate the use of national standards and regulations as impediments to international trade. Section 6.3.3 deals with this subject in detail.

3.5 The United States and International Standards: 1980-?

In concert with the escalation of national standards activities in the 70's was the growing U.S. interest in international standardization. The ongoing interest of the 80's reflects several interdependent, worldwide developments that will affect the immediate and long-term future of the United States. Prominent among these developments are: the widespread recognition of the economic effects of standards in world trade; political issues including the role played by the developing countries; and the rapid advances in telecommunication and information-processing technologies, the union of which has not only emphasized the interdisciplinary approach to standards, but has given birth to the "Information Revolution."

The overall effect of the above-mentioned worldwide developments (trade issues, politics, technology) on international standards organizations is twofold. First, the international standards organizations are undergoing major re-evaluation of structures that have served well (in some cases for a

Table 2.   A Partial List of Voluntary Standards-Related Activities in the
Private and Public Sectors Since 1975

Date	Source	Format	Title
1975	American Society of Testing and Materials (ASTM)	Report	The Voluntary Standards System of the United States of America
1976	ANSI	Conference	An Evaluation Update of America's Voluntary Standards System
1976	Administration	Task Force	Presidential Task Force on the Revision of OSHA Standards
1976	ANSI/Dept. of Labor	Memorandum	ANSI-OSHA Memorandum of Understanding
1976	Dept. of Defense	Instruction	Instruction 4120.20: Development and Use of Non-Government Specifications and Standards
1976	Senate	Proposed Bill	S.3555: The Voluntary Standards and Certification Act of 1976
1977	Senate	Proposed Bill	S.825: The Voluntary Standards and Accreditation Act of 1977
1978	Federal Trade Commission (FTC)	Proposed Rule	Trade Regulation Rule for Standards Certification
1978	Office of Management and Budget (OMB)	Circular (see 1980 and 1982 below)	A-119: Proposed-Federal Government Participation in Non-Government Voluntary Standards Organizations
1979	National Bureau of Standards (NBS)	Report	Regulatory use of Standards: The Implications for Standards Writers
1979	National Standards Policy Advisory Committee (NSPAC)	Document	National Policy on Standards and a Recommended Implementation Plan

Table 2. (continued)

Date	Source	Format	Title
1979	General Agreement on Tariffs & Trade (GATT)	Code	The Agreement on Technical Barriers to Trade ("The Standards Code")
1979	Congress	Act	Title IV of the Trade Agreement Act of 1979 (Implementation of GATT Code)
1980	OMB	Circular	A-119: Final--Federal Participation in the Development and Use of Voluntary Standards
1980	Committee on International Standards CIS/ASTM	Report	The Role of the U.S. Federal Government in International Standardization Activities
1982	ANSI	Survey	Survey of ANSI Membership Interest in International Standardization
1982	International Trade Association (ITA)	Guidelines	Voluntary Guidelines for State and Local Governments, and Private-sector Bodies Engaged in Standards Development, Product Testing, and Certification Systems
1982	OMB	Circular	A-119: Revised-- Federal Participation in the Development and Use of Voluntary Standards
1983	Dept. of Commerce	Committee	Department Committee on Standards Policy
1983	FTC	Report	Standards and Certification; Availability of Final Report
1984	Interagency Committee on Standards Policy (ICSP)	Guidelines	Guideline Documents Implementing Federal Standards Policy (Federal Register, 1984): 1. Guidelines for Participation by U.S. Government Agencies, Employees, or Representatives in International Standards-Related Activities 2. Guidelines for Federal Agency Use of Private Sector Third-Party Certification Programs 3. Guidelines for Federal Agency Use of Self Certification by Producer or Supplier

century), and in general they look to eventual reorganization. Second, the international standards writing bodies are rapidly shifting from the traditional "reactive" process, harmonizing and coordinating fully developed national standards, to the "proactive" process, becoming primary standards writers whose work will precede national standards. This latter process is particularly obvious in telecommunication and computer standardization. Consequently, both the U.S. Government and the leaders in the U.S. voluntary standards community are encouraging broader, more effective U.S. participation in international standardization to ensure that the United States has a clear, timely voice in these developments.

   3.6 Implications for the Future of the U.S. Standards Community
    From the above discussion of the development of the U.S. standardization environment, from nuts and bolts to extensive involvement in worldwide computer networks, several changes are evident. These changes have projected the U.S. standards community into a period of vitality, unprecedented growth, and uncertainty.
    Formerly, national standardization was concerned with very concrete, practical matters, such as structural elements. The necessity, and therefore the goal, of the effort was clear and comfortably limited; the advantages of these standards were obvious to everybody concerned. There was little political or economic impact. The process of standardization was relaxed and predictable.
    Today, the situation facing the national bodies is entirely different. The subjects proposed for standardization are much more complicated and the potential effects of the standards are increasingly difficult to evaluate. The balance between resources and requirements is also more precarious because it concerns adjustments to international standards and participation in their development. The political--and policy--activities of the 70's assured that "now and forevermore the national standards . . . and related activities in the United States are highly political issues" (Cavanaugh, 1980).
    The U.S. national standards scene is increasingly affected by the international situation. The rapid, unpredictable changes in the world economy and in international markets, combined with the far-reaching implications of the OSI and ISDN efforts for world communications, have affected the standards environment, worldwide. Today, the international organizations are trying to deal with a politicization of the standards effort

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that is largely a consequence of the developing countries' dilemma concerning involvement in the development of and the meaning and use of standards (see Section 6.4). The economic impact of standards is newly appreciated, worldwide, resulting in a surge of increased interest and participation and a demand for more standards. The development of these new standards must be accelerated to keep pace with scientific, technological, and social progress.

Consequently, the standards process appears complex, confusing, and difficult to follow from the outside. This complexity, and perceived confusion, may prevent companies from being able to be fully involved in the process. The future standards world will require changes in structure and operation, and it is a risk to be involved and a risk not to be involved in these tasks. Involvement for the individual, the company, and the nation comes at a cost--financial, personal, competitive, technological--and some believe that this cost is too high. The serious, new burdens offer the standards community a challenge just to keep the process working at all.

The remaining sections of this report provide an informational background that may be helpful in evaluating one's position in this "brave new world" of universal standards--and how much one is willing to pay to participate in it. To survive in this new world, the standards writer will have to be a special person, possessed of negotiating skills as well as, or even more than, technical expertise. The final section of this report discusses some desired characteristics of the standards writer gleaned from standards writers long in the field.

4. DEVELOPMENT AND USE OF U.S. STANDARDS AND REGULATIONS

The development and the implementation of a standard are two halves of the process often referred to as "setting a standard," or standardization. The first half, the standard's development or formulation, involves organizational acceptance of the original standards project, the writing of the standard, the approval of the standard, and the publication of it. The mechanism used in the standard's formulation determines the ultimate value of the standardization effort. History has shown that the potential use of a standard is in proportion to active participation by all affected parties who can freely express their biases and expertise with confidence that their efforts will produce tangible results.

The second part of standardization involves the procedures by which the developed standard is put into effect, or implemented. In the United States,

the extent and manner of implementation of voluntary standards is left to the discretion of the users for the most part. Increasingly, however, voluntary standards are "referenced" in Government regulations. This relationship between voluntary standards and regulations is explored in Section 4.2.

Although formulation and implementation are two distinct aspects of standardization, each with its own complexities, the formulation process is so influenced by possible manner of implementation that they are considered together in this section of the report.

4.1 The U.S. Voluntary Standards System

The U.S. voluntary consensus standards system is a successful, 100-year old development of the democratic ideal. Traditionally, it has permitted industry and the public to produce the standards (as the need arose) that have formed the basis for commerce. As such, it is "the only process that stands between economic chaos and Government over-regulation on the one hand, and the exercise of a truly competitive marketplace on the other" (Zerlaut and Garner, 1983).

The importance of the voluntary consensus standards system can be measured by the number of organizations involved, the number of standards in use, and the amount of money spent in maintaining the system. The more than 400 private-sector organizations that write standards or sponsor standards-writing activities include professional societies, standards organizations, and trade associations. These organizations range from the ASTM, the world's most prolific nongovernment standards writing body, to trade associations that may have developed only one or two standards. The participants are the hundreds of thousands of individuals from the private sector and from the Government who voluntarily contribute their knowledge, talent, and effort to standards development. These organizations have developed and maintain over 32,000 major voluntary commercial standards. About 85% of these standards have been developed by 14 of the 400 organizations.

4.1.1 Voluntary Consensus Standards

Voluntary standards are voluntary in at least three ways: they are developed by volunteers who are not paid for their efforts by the standards organization, they are implemented voluntarily, and in a legal sense the practical consequences of departing from the standards are relatively minimal.

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Many voluntary standards are developed in the consensus mode in the United States although consensus is not always achieved or needed at levels below the national. A consensus standard is one produced by a body that is selected, organized, and conducted in accordance with the procedures of "due process" (discussed below). Consensus is achieved when "substantial agreement has been reached by directly and materially affected interests" (ANSI, 1983a) according to the judgment of duly appointed review authorities. Consensus implies more than a simple majority, but not necessarily unanimity. Unanimity can often be achieved only by compromises that reduce the quality of the standards. Consensus requires that all views and objections be considered, and that concerted efforts be made toward the resolution of all objections. This system is based on the following "principle":

> If in the standards preparation process all relevant knowledge [is brought to bear] and representatives of all concerned groups participate in reaching the most credible decision regarding a standard, the resulting standard will be unassailable (Cavanaugh, 1977).

The means of developing proof that consensus has been reached is the written ballot. The participant can vote yes or no, or can abstain. Rules differ among organizations for dealing with the "no" votes, but reasons must be listed for the negative votes and these reasons must be considered. An abstention does not necessarily mean a lack of knowledge, but may be as meaningful as a negative vote, even though not (ordinarily) required to be accompanied by reasons. A significant number of no votes and abstentions "would at least suggest that the quality of the consensus is not what it should be and may imply a lack of communication" (Abdun-Nur, 1983).

4.1.2 Consensus through "Due Process"

Voluntary consensus standards are developed by private organizations that observe the following principles:

1. Technical committees, in their development, review, and revision of the standards, follow open and regular procedures including a process for considering and attempting to resolve negative comments.

2. Membership on technical committees is broad based and "balanced" (manufacturers, suppliers, users) in an effort to assure representation of varying points of view and avoidance of domination by a single interest.

3. A review mechanism is in place to assure compliance with prescribed procedures and an appropriately balanced membership (1 and 2 above).

These principles have evolved gradually in the United States. Ideal voluntary standards development is a democratic process in the truest sense of the term, based on the consensus method that integrates varied views into a single view providing optimal benefits to all parties involved. A wide range of standards volunteers is the basic key to the success of this process.

Voluntary U.S. standards, in general, fall into broad categories based on the degree of consensus needed for their development (and use):

1. Company Standard: agreement is among the employees and management of an organization. Company standards are useful to the firm's design, development, production, purchasing, and quality control activities. These sometimes become "ad hoc" industry standards.

2. Industry Standard: consensus is among the many companies within the trade association (the typical developer). Distributors and users, as well as manufacturers, are often involved, and such groups are best able to recognize the need for the standard. These standards are generally focused on matters that are of concern only to the industry. A similar kind of standard is produced by professional societies (e.g., American Chemical Society) with the consensus being among the individual members of a given profession.

3. Interindustry Standard: consensus must be broader because these standards apply to products manufactured by one industry and used by one or several others. A great deal of coordination in the standards development is necessary to keep the number of standards to the minimum required to serve the combined needs. It is for this reason that standards-developing organizations are important, since they can provide for essential coordination and communication in standardization efforts that are applicable to several industries and trade associations.

4. National Standard: the full consensus standard has participation by representatives of all sectors that have an interest in the use of the standard, including users, Government representatives, and academicians. The principal groups (among the several hundred) involved in national standards developing activities are:

   a. Testing laboratories, of which Underwriters' Laboratories is the best known because of its certification procedures;

   b. Professional societies, such as the American Society for Mechanical Engineers (ASME), the Institute of Electrical and Electronics Engineers (IEEE), and many others;

   c. Nonprofit membership organizations, such as the National Fire Protection Association (NFPA) and ASTM; and

   d. A large number of independent committees loosely affiliated with trade associations, and other organizations, that are expressly founded for the purpose of creating national or consensus standards.

Many standards developers and participants support ANSI as the central body responsible for the identification of a single consistent subset of the

national full-consensus standards (No. 4 above) called American National Standards (ANS). An ANS is a standard that has, or could reasonably be expected to have, a significant effect upon a substantial number of U.S. citizens. Each standard approved by ANSI as an American National Standard must be subjected to examination by ANSI concerning its method of development. The "Procedures for the Development and Coordination of American National Standards" (ANSI, 1983a) used by ANSI in this process express in detail what constitutes the "minimum acceptable due process requirements for the development of consensus." The role of ANSI in accrediting individual organizations and committees by assuring that they follow appropriate procedures is discussed in Section 5.

Due process in standardization activities means that everyone with a direct and material interest has a right to express a viewpoint and, if dissatisfied, to appeal at any point. The principle of due process assures equity and fair play. The term "due process" stems from an article in the U.S. Bill of Rights that stipulates that no one can be deprived of the benefits of his property except by "due process of law." This right includes the ability to speak in one's own behalf and to seek redress. A true consensus standard can be written only if this principle is strictly adhered to in the entire development procedure.

According to ANSI, due process demands:

1. Openness: timely and adequate notice for proposed standards activity to all persons likely to be materially affected by it; published source for further information; no undue financial barriers to participation; and no unreasonable conditions set on participation.

2. Representation of Interests: opportunity for all affected interests to participate without dominance by any single interest, usually satisfied by historical criteria for balance, i.e., a) no single interest constitutes more than one-third of the membership of a committee dealing with safety, or b) no single interest constitutes a majority of the membership of a committee dealing with product standards.

3. Categories of Interests: at least three categories must be considered--producer, user, and general interest. Users shall be actively sought from public and private sectors.

4. Written Procedures: written procedures that govern the methods used for standards development shall be available to any interested party.

5. Appeals Mechanism: the written procedures shall contain an identifiable, realistic, and readily available appeals mechanism for

the impartial handling of substantive and procedural complaints regarding any action or inaction.

6. Listing of Proposals Needing Balloting in ANSI's "Standards Action": the public comment period shall be at least 30 days but normally it will be 60 days (see Section 5 for further discussion).

7. Consideration of Views and Objections: a prompt, concentrated effort to resolve all expressed objections. Unresolved objections and any substantive changes are open to revoting.

8. Consideration of Standards Proposals: prompt consideration to proposals made for developing new standards, or revising or withdrawing existing American National Standards.

9. Records: maintained records of standards activity should permit an overall view of what happened. Such records should minimally include drafts of proposed standards and amendments, resultant actions and supporting data, meeting reports, ballot results, and disposition of objections (after ANSI, 1983a).

4.1.3 Criticisms of This Process

The historical general criticisms of this process, flowing from the nature of the process itself, are: the procedure used in reaching a consensus is too time consuming, the spectrum of views is too narrow, and consumers are not adequately represented on committees.

All these problems remain a source of frustration and anxiety to standards organizations. The standards developer is obliged to sometimes trade-off speed of process for the exchange of views so essential to keeping the complex process on course. Slight deviations from the carefully designed principles of due process may be maximally counterproductive. Decisions imposed by a chairman before all parties were heard, for example, would assure serious problems. Nevertheless, the question is increasingly asked, "How much consensus is enough?"

The balance of interests in committees is another genuine concern, especially in terms of users/consumers. Efforts made to attract consumers continue, but problems emerge that are conceivably destructive to the process. The answer to the often-asked question, "How much technical expertise is needed by a committee participant?" is elusive. Often, in increasing the consumer participation, the time for standards development is also increased because of the need to establish some basic level of technical understanding.

There is great interest today in ascertaining sufficient user/consumer participation. This is particularly true in the development of telecommunication and information processing standards. The users, whose presence at standards meetings is not only welcome but essential:

... must voice their needs and their opinions, so that suppliers
know what is wanted and needed .... If the users do not enter
the standards-developing process early, it can be a very long time
before they are able to get what they really want. User interest
that is too little, and/or too late, can and has both delayed the
good aspects of standards and permitted inadequate (from the user's
point of view) standards to be developed .... Intrinsic to the
involvement is balance. If the user requirements are too high, too
costly, or unrealistic, the [providers] on the committee will be
there to modify the request (Cerni and Gray, 1983).

User groups with an interest in standards work have emerged nationally,
regionally, and internationally. In many cases, technology is not their only
consideration or even their prime consideration, but rather such concerns as
the resultant cost, safety, or quality. An overwhelming factor in user
noninvolvement is the expense of participation.

4.1.4 Legal Aspects of the Voluntary Standards System

Although the heart of a voluntary standard is its technical credibility,
it must also stand on four legal principles in the United States, if it is to
be upheld in litigation. These principles involve due process, restraint of
trade, authority and responsibility, and liability (ASTM Standardization News,
1977). Therefore, in the development of a standard, the writers, and
particularly the organization sponsoring the standard, must ascertain that the
standard rests on a sound legal foundation.

The requirements for the first principle, due process, have already been
detailed in Section 4.1.2. The second issue, restraint of trade, refers to
any discriminatory, anticompetitive effects, whether they stifle innovation or
exclude potential competition from established markets. The third principle,
authority and responsibility, refers to the duly authorized organization, and
the responsibilities it carries a) to spell out clearly the procedures in its
bylaws; b) to maintain its standards and uphold them against technical or
legal attack; and c) to assure competent sources of technical expertise. The
fourth legal principle is liability. This concerns the potential legal
liability of the persons serving on the standards writing committees, the
liability of the committee itself, and the liability of the organization
sponsoring the committee.

In a 1977 general article on standards, the statement was made that most
if not all states have laws to the effect that "members of a nonprofit
corporation shall not be personally liable for the debts, liabilities or
obligations of the corporation." This was followed by the statement:

> [I]t would appear safe to say that whenever a nonprofit standards
> organization is chartered, its members, including its officers,
> would be free from personal liability should litigation occur.
>
> Liability could be imposed upon the corporation that holds itself
> out as an expert on standards and publishes these standards for use
> by the public. Thus, if a suit were instituted for negligent
> misrepresentation (and that is the essence of legal liability), the
> corporation and not the individual would be the primary target
> (ASTM Standardization News, 1977).

This statement proved to be prophetic, as discussed below.

The question of the potential liability of a standards writer and standards organization has always been of concern. However, this topic has received greater interest within the standards community since the 1982 U.S. Supreme Court decision on the "Hydrolevel Case." This case involved three of the four above-mentioned principles with only "due process" excluded.

The Supreme Court has rarely dealt with issues emanating from the standards community because health and safety issues are largely the domain of state and local governments. In fact, "the Court has called the legal authority to enact and administer health and safety codes and standards--the police power--one of the 'least limitable of Government powers'" (Markman, 1983). However, the Court did choose to hear and decide the case of Hydrolevel Corporation v. American Society of Mechanical Engineers. The incident of concern happened in 1971. The suit was filed in the lower courts in 1975. The resultant decision of the lower courts was appealed by ASME to the Supreme Court and the decision was handed down in 1982.

On May 17, 1982, the Supreme Court ruled, by a 6-3 margin, that ASME was liable for conspiracy under Federal antitrust statutes for the actions of two of its volunteer subcommittee members who caused ASME to unknowingly issue a misinterpretation of a standard that resulted in competitive disadvantage to, and eventual destruction of, Hydrolevel Corporation. The 7.5-million-dollar fine of the lower court was upheld. The interested reader is referred to Markman (1983) for a complete summary of this case.

There were originally three defendants in the Hydrolevel Case. The other two were the firms to which the ASME volunteers belonged. Since both of these firms settled out of court, no information on their liability could be established.

The majority of the Court was more concerned with the ease with which ASME's procedures had been abused for anticompetitive action than with ASME's

innocence and nonprofit status. Although all parties seemed to agree that no one had acted to further ASME's interests, the Court found that to be:

> . . . simply irrelevant to the purposes of the antitrust laws. Whether they intend to benefit ASME or not, ASME's agents exercise economic power because they act with the force of the Society's reputation behind them. Whether they act in part to benefit ASME or solely to benefit themselves or their employers, ASME's agents can have the same anticompetitive effects on the marketplace. The anticompetitive practices of ASME's agents are repugnant to the antitrust laws even if the agents act without any intent to aid ASME, and ASME should be encouraged to eliminate the anticompetitive practices of all its agents . . . especially those who use their positions in ASME solely for their own benefit or the benefit of their employers (Markman, 1983).

A side effect of the decision was the acknowledgment of the economic importance of the voluntary standards community. Besides making new law, the decision offers social and economic policy:

> When ASME's agents act in its name, they are able to affect the lives of large numbers of people and the competitive fortunes of businesses throughout the country. By holding ASME liable under the antitrust laws, . . . we recognize the important role of ASME and its agents in the economy, and we help to insure that standards-setting organizations will act with care when they permit their agents to speak for them. We thus make it less likely that competitive challengers like Hydrolevel will be hindered by agents of organizations like ASME in the future (Markman, 1983).

The Hydrolevel Case is of interest for several reasons, one of which is that it reveals the importance of the legal issues discussed above, particularly the authority and responsibility of the standards organization. The case implies that increased liability is borne solely by the organization and not its members. Attention in this case was focused on interpretation of standards, and many standardization groups have already taken the steps necessary to formulate procedures designed to assure adequate review of standards interpretations. The implementation of these procedures "will assure that . . . potential liability of members will remain very remote" (Boyer, 1982). The fundamental lesson to be learned from this case is that the concepts of consensus and due process utilized to develop and revise standards must be extended to the area of standards interpretation.

This legal and political/social dimension of standardization becomes more important for standards written to meet regulatory needs, as discussed in Section 4.2.3. This applies whether the nongovernment standard is written specifically for regulatory use (i.e., written on request of the regulatory

agency) or whether it is written primarily for voluntary use but becomes referenced in a regulation.

The reader interested in the legal issues related to standardization will find the texts of four speeches that were presented at the 1984 ANSI Public Conference on Standards and the Law in the booklet, "Standards and the Law." This booklet is available from ANSI.

4.2 U.S. Federal Regulations

Standards may be implemented either voluntarily or by Government regulations. The distinction between regulations and standards is of major concern to those who develop and apply voluntary standards in the United States. The implementation of a standard is perhaps one of the most complex operations in the discipline of standardization, especially in the United States where the voluntary consensus system has achieved such success.

To ensure a common understanding of "Federal regulation" as used in this report when discussing the relation of regulations to voluntary standards, this section includes general background material on U.S. Government regulatory activity. Reasons for the increased use of voluntary standards in regulations are presented, and the significance of this activity to standards writers is addressed. The reader interested in pursuing this topic will find comprehensive material in the Federal Regulatory Directory 1983-1984 (Lammers, 1983). This directory contains an 80-page discussion of the regulatory process in addition to a description of each of the 113 regulatory agencies.

4.2.1 General Overview of Federal Regulatory Activity

The Constitution granted Congress the legal right to "regulate Commerce with foreign Nations, and among the several states . . ." (U.S. Constitution, Article I, Section 8). Congress has traditionally delegated this function to various administrative executive-branch agencies and to especially created independent agencies. Included among the major regulatory agencies are; the Food and Drug Administration (FDA), the Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA), the Consumer Product Safety Commission (CPSC), the Nuclear Regulatory Commission (NRC), and the Federal Communications Commission (FCC). The 113 regulatory agencies differ widely in composition and function.

Over two centuries of regulatory activity has not succeeded in producing a universally agreed upon definition of a Federal regulation. There is,

however, general agreement on two points. The first is that regulations entail sanctions to discourage undesired conduct, and the second is that regulation transfers some amount of private discretion to the public sector.

In 1977, a Senate Committee defined a "Federal Regulatory Office" as one which:

1. has decision-making authority,
2. establishes standards or guidelines conferring benefits and imposing restrictions on business conduct,
3. operates principally in the sphere of domestic business activity,
4. has its head and/or members appointed by the President (generally subject to Senate confirmation), and
5. has its legal procedures generally governed by the 1946 Administrative Procedures Act (Lammers, 1983).

The late 60's and the 70's produced the most dramatic increase in Federal regulatory activity ever observed in the Unites States. This growth took place not only in quantity, but also in "government penetration into the daily decision-making activities of nearly all areas of management in the modern American firm" (Lammers, 1983). The Federal Register, which publishes all proposed and final regulations, skyrocketed from 9,562 pages in 1970 to 87,012 pages in 1980. (In 1983, this had dropped to 57,704 pages.) The Reagan Administration has estimated that the cost to each American family to comply with Federal regulations is $1,800 per year.

Continuing widespread reaction to this growth of regulatory activity, both within and outside Government, has not yet succeeded in a satisfactory determination of what should or should not be regulated, nor how much regulation is a good thing. These policy-related issues prove difficult to resolve.

4.2.2   The Federal Communications Commission (FCC): an Independent Regulatory Agency, Telephone Deregulation, and the ISDN

The regulatory problems faced by the FCC as the new technologies of the 70's intruded on long-standing regulations based on older techniques exemplify the regulatory uncertainty mentioned above. For many reasons, "neither the White House nor the Congress was prepared to make controversial policy choices to resolve the conflicts in ways that would benefit the national communications and information structure" (Dizard, 1982). The task then fell to the FCC, which as an independent regulatory agency is not directly

accountable to Congress or to the President, although it clearly must take into account recommendations from both of these sources. The Commissioners hold final authority (subject to review by the Federal courts) in all matters under FCC jurisdiction. The past decade of FCC activity has been affected by hesitancy and ambivalence, often resulting in "unclear and sometimes contradictory decisions" (Weber, 1983). According to Dizard (1982):

> The FCC's problem is in coping with the bits and pieces of important communications and information matters in the absence of a clearly articulated national policy. The Commission is less a regulator in a traffic cop sense than a referee without an up-to-date rulebook or even a clear whistle.

Even so, the FCC has moved on many pressing issues in the past years, with its Notice of Inquiry on the ISDN (discussed below) one of the latest.

The following discussion traces the purpose and responsibilities of the FCC and includes a sketch of the activities that have resulted in extensive telephone deregulation.

Background

The FCC is an independent regulatory agency, established half a century ago to consolidate several Governmental authorities responsible for communications. The five Commissioners (reduced from seven in 1983) are nominated by the President and confirmed by the Senate. The organization of the FCC is indicated in Figure 4 (Lammers, 1983).

The FCC exercises its authority under two Congressional Acts. The first is the Communications Act of 1934 that established the FCC and consolidated all the communication regulation responsibilities that had been spread among other agencies. The second Congressional Act is the Communications Satellite Act of 1962 that created the Communications Satellite Corporation (COMSAT) and gave the FCC authority to regulate the corporation and its activities.

The FCC has been carrying out its mandate by regulating a communications industry characterized by rapid evolution in spite of having a 1934 framework (with amendments) within which to work. The innovative technology of the past 50 years has ranged from commercial television to the ISDN. Extensive ongoing Congressional action in recent years to "rewrite" the 1934 Communications Act has not yet succeeded.

The FCC regulates national and international communication by radio, television, wire, and cable. It is responsible for many industry practices as well as technical regulations, particularly in the areas of radio and

FEDERAL COMMUNICATIONS COMMISSION
(FCC)
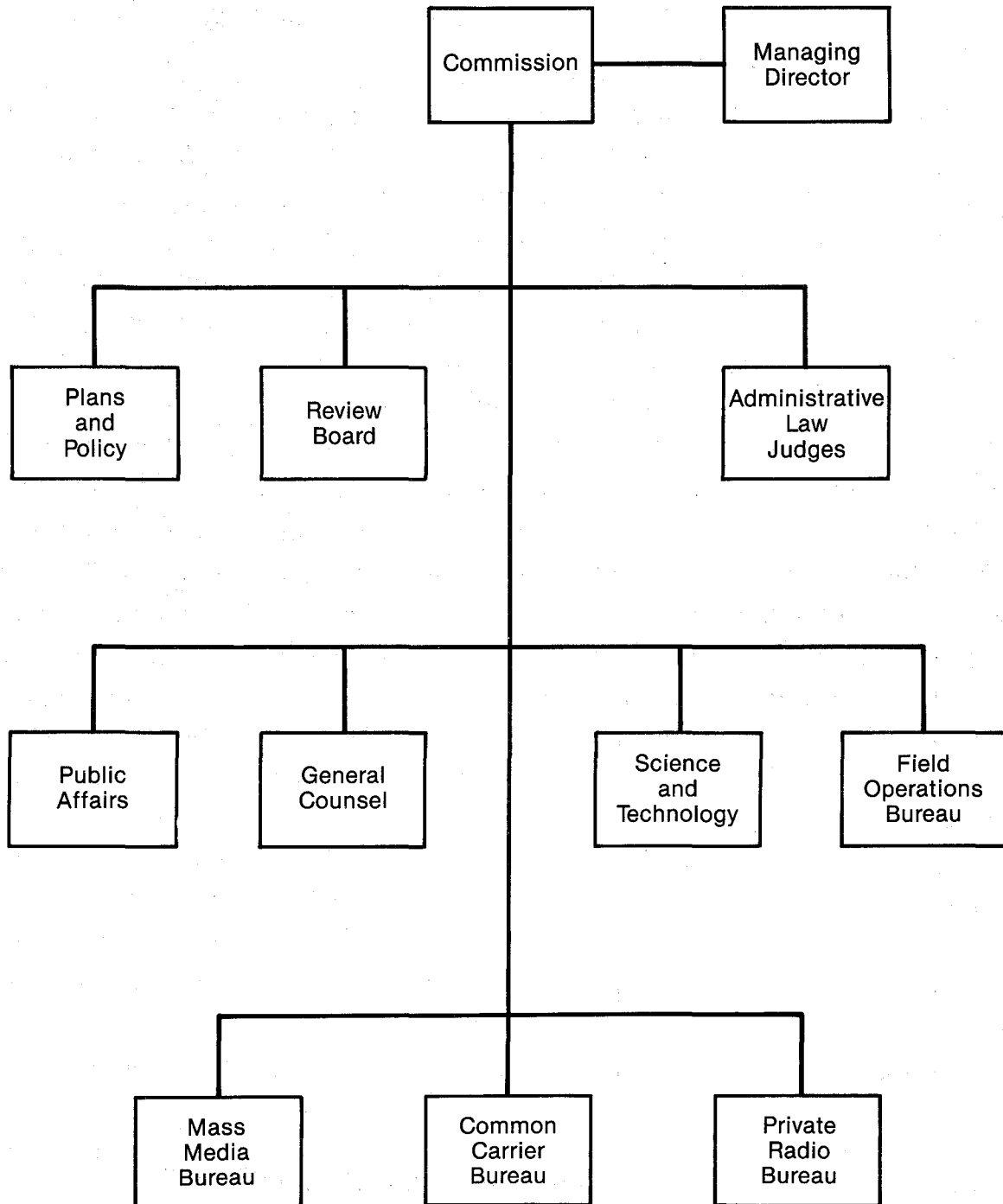
Figure 4. The organization of the Federal Communications Commission (FCC).

television. Most of the regulatory activities are divided among three bureaus: the Mass Media Bureau, the Common Carrier Bureau, and the Private Radio Bureau.

The Common Carrier Bureau (CCB) is of specific interest in this report. Communication common carriers provide telephone, telegraph, facsimile, data, telephoto, audio and video broadcast program transmission, satellite transmission, etc., all considered "services for hire." Common carriers are required by the Communications Act to furnish service upon request and at reasonable rates. Principal Common Carrier Bureau functions include the responsibilities to:

1. assist, advise, and make recommendations to the Commission, on the regulation and licensing of interstate and international communication common carriers,

2. assist the Commission in policy development,

3. conduct rule making proceedings,

4. review carrier performance,

5. develop financial reporting systems that carriers must follow, and

6. carry out compliance activities (Lammers, 1983).

Federal regulation of interstate communications began in 1866 with telegraph considerations. Broadcast regulation started at the turn of the century. Telephone regulation began in the early years of the century following a highly competitive beginning of the telephone industry (1876-1907). In 1908, "the Bell System embraced regulation in exchange for what was generally deemed to be the most efficient form of telecommunications—a single supplier in each geographical area and a single provider of service to interconnect these areas" (Weber, 1983). By the 60's, this regulatory system had achieved great stability, although events proved this to be short-lived.

During the late 70's, the FCC gradually reduced its regulatory grip in almost all communication areas. By 1982, the Commission was "committed to deregulation of competitive telecommunications markets" (Lammers, 1983). At present, the FCC strongly promotes new entry and the development of new services. Where deregulation is not yet possible (because competition is still developing or for other reasons) the FCC is committed to transitional measures that promote competition. (A summary of FCC deregulatory activities can be found in Lammers, 1983.)

Telephone Deregulation

Recent actions of most importance to this report are those affecting the nation's telephone service and ultimately the nation's telecommunication standards. The 1982 settlement of the 1974 antitrust case between AT&T and the U.S Justice Department is probably the most significant regulatory (deregulatory) development in U.S. history. AT&T was required to divest itself of ownership of 22 local Bell telephone operating companies and the "Yellow Pages". Of the new AT&T holdings, only the long distance business remains regulated.

Under the terms of the decree, the local exchange carriers that have been previously affiliated with the Bell System are prevented from providing long distance service. There is no such restriction placed on the non-Bell, or "independent," telephone companies. There are no restrictions on the services that may be offered by the interexchange carriers, including AT&T, except that AT&T may not reacquire the Bell telephone companies, nor for seven years enter the electronic publishing business if the information is carried on its own facilities.

Telephone service in the United States, universally recognized as among the best in the world, has been provided by an industry partnership dominated by the Bell System for over 100 years. The Bell System services 80% of the approximately 200 million telephones in the United States, and the almost 1500 independent telephone companies service the remainder. These non-Bell companies service 44% of the geographical area, and the Bell System services 30% (Hart, et al., 1982). (The remaining 26% is "undesignated" land, i.e., mountains, lakes, swamps, etc.) The inter-relation of these companies with Bell has been cooperative rather than competitive. The independent telephone companies, after the stormy competitive beginning, in 1908 essentially "adopted the Bell System's planning procedures and technical standards, and, in partnership with the Bell System, have cooperated to provide . . . good service universally throughout the country at reasonable prices" (Weber, 1983). This 75-year-old cooperative system is now changing as it adapts to a more competitive environment.

The beginning of the move to competition can be traced to a 1949 antitrust lawsuit filed by the U.S. Government against AT&T. At that time, AT&T was threatened with the loss of the Bell companies. This suit was settled in 1956 by the "Consent Decree" that kept the Bell System intact but put certain conditions on AT&T activities. One major condition was the

restraint put on AT&T to restrict its business to regulated common carrier communications. AT&T was prohibited from engaging in nonregulated businesses, notably data processing. Although this restraint seemed unimportant at the time, it later became critically important as technology made telecommunications and data processing almost indistinguishable.

By 1965, the limitations of the Consent Decree were becoming quite obvious. Computers were not regulated by the FCC, but they were being incorporated into the regulated telephone network as switches and as message storing devices. The FCC has jurisdiction over both voice and record (e.g., Western Union) carriers, but not over computers and data processing. (Nor did the FCC wish to extend its regulatory activity to data processing.)

Faced with growing regulatory uncertainty, arising from the convergence of telecommunications and data processing, the FCC issued its 1966 Docket 16979, a Notice of Inquiry known as "Computer I Inquiry." This asked for public and industry comments on the impact of data processing on communications. The two critical issues were:

1. The nature and extent of FCC regulation that should be applied along the continuum from pure data processing to pure communications.

2. Whether, and if so, under what circumstances and subject to what conditions or safeguards, common carriers should be allowed to provide data processing services.

In the late 60's, the trend in data processing was the use of large, centralized mainframe computers. The Computer I decision was based on this technology, in which the boundary between communications and data processing was still relatively clear. The deliberations were based on an FCC distinction between unregulated data processing and permissible carrier utilization of computers in the network. By considering "pure" data processing and "pure" communications (circuit switched) to be at opposite ends of a nonregulated-regulated continuum, two "hybrid" middle "gray" sections were defined. The unregulated hybrid data processing functions, to the left of center on the continuum, were mostly those of data processing with message switching used incidentally as a feature of an integrated service offering. The regulated hybrid communication functions--to the right of center-- consisted of a message-switching service wherein the data processing functions were incidental and were offered to satisfy the subscriber's message-switching requirements. The hybrid communication services were thus viewed as a

substitute for point-to-point services offered by a conventional communications carrier.

The Computer I Decision, made 5 years after the 1965 Notice of Inquiry, introduced the policy of "maximum separation" that required a common carrier to develop a separate subsidiary to enter the data processing market.

By the mid-70's, new technological developments were further clouding the once-clear distinctions between telecommunications and data processing. The new trend in data processing, distributed processing, was requiring more and more network use.

Concurrently, the increasing incorporation of computers (and software) into the telephone network, and the use of data processing functions in Private Branch Exchanges (PBXs) led the FCC to open the "Computer II Inquiry," Docket 20828, in 1976. The Computer II Decision, made in 1980, distinguished between regulated "basic" (transmission) service and nonregulated "enhanced" services. This eventually led to the retention of "maximum separation" for AT&T only; other carriers could combine basic and enhanced services.

Meanwhile, a combination of factors led to certain other problems that emerged in 1968 and 1969. The factors were "a desire to restrict the growth of the Bell System, an increasing desire for diversity on the part of the American public, and the advent of new technology," such as microwave radio, semiconductors, etc. (Weber, 1983). The resultant FCC decisions included:

1. Carterfone (1968): the Supreme Court opened the door to eventual competition in the terminal equipment field by permitting non AT&T equipment to be connected to the AT&T system.

2. Specialized Common Carrier (1969): FCC allowed other carriers to build microwave communication systems and lease private lines for resale (involving connection to local lines).

The connection of competitive long-distance facilities (e.g., MCI) to the exchange telephone network proved to be a complex, bitter issue, resolved in and out of court. It began the unravelling of a telephone practice, long recognized, of subsidizing local service by long-distance service. Resolution of the subsidy issues is yet to be achieved.

The 1982 antitrust settlement between AT&T and the U.S. Justice Department, effective since January 1, 1984, leaves many unanswered questions. Two universal underlying concerns of the user in this new uncertain competitive environment are, "Will there be additional costs to the user-- today and tomorrow?" and "Will the service maintain its traditional quality?"

One major technical issue has to do with the plans for the total network, including systems engineering, quality assurance, total operations, and other functions. Heretofore, as was mentioned above, this complex technical effort was undertaken largely by the Bell System and the independents adapted to it. Network planning is an extremely complex function, requiring the combination of many technologies from many different eras (the last hand-cranked telephone, for instance, was removed from service in 1983) to support a wide spectrum of services, both analog and digital. The size of the U.S. telecommunication network complicates the problem: 22,000 Bell and independent switching offices; more than a billion miles of transmission paths, including 6 million trunks; almost as many special services circuits; and about 100 million loops connecting customers to central offices. The network permits 6 million billion possible connections and must reliably handle about 750 million calls every day (Falconer and Powers, 1983). The post-divestiture network planning is dealt with in detail by Falconer and Powers (1983), who state, from a pre-divestiture perspective:

> Planning has always been a cooperative effort of Bell System people and, sometimes, the independent telephone companies. Today, Bell Labs recommends to AT&T the overall design or architecture of the Bell System network, methods for planning and designing it, and the performance standards that should be met. AT&T disseminates these plans to Long Lines and the Operating Companies, who participate in the planning process and are responsible for the detailed planning and implementation decisions. Post-divestiture, the Operating Companies' planning will be supported by their Central Services Organization, rather than Bell Labs and AT&T.

The Central Services Organization (CSO), mentioned in the above quote, is now called the "Bell Communications Research Inc." (BCR) and commonly referred to as "Bellcore." It is "dedicated to telecommunication efficiency in an environment being rapidly changed by the advent of the Information Age and by divestiture itself" (Kinkead, 1982). Bellcore is mandated to provide expert support to the seven regional Bell Operating Companies (BOCs) by focusing primarily on the technical aspects of exchange telecommunication services and other services that can be efficiently centralized. The majority of the workforce of almost 9000 have the job of "making sure that the regional Bell Operating Companies have the right technology available to them at the right time" (Kinkead, 1982). The original composition of the BCR workforce was about 49% from Bell Labs, 22% from AT&T, 12% from Western Electric, and 17% from the operating companies and from outside hire (Telephony, 1983). This

technical force is about evenly divided between information systems and network functions including technology systems, engineering, network planning, and applied research.

Recommending technical standards for operating companies is one function of Bellcore. As the BOCs' agent, Bellcore aims to "help the [BOCs] contribute to the establishing of standards which benefit the public through ubiquitous, procompetitive network designs" (Dorros, 1983). The question of national telecommunication standards for exchange carriers is considered later in this report in Section 5.4.3 (dealing with the Exchange Carriers Standards Association and its standards committee, T1). New procedures are outlined for post-divestiture development of national telecommunication standards.

Although the primary responsibility of Bellcore is to keep the BOCs in the forefront of technological development, Bellcore will also have contractual arrangements with other telephone companies, offering such services as exchange telecommunications and access-related telecommunications planning, and to an extent, quality assurance and related data systems (Telephony, 1983).

One additional issue that includes all concerns mentioned and unmentioned is the ISDN, involving both national and international standards and all networks--voice and data. A clear goal of AT&T in the past few years has been to work toward the development of the ISDN, both in upgrading its own network and in active CCITT participation. A crucial challenge to the U.S. telecommunication network will be the ongoing development of facilities and services that meet the customer's current needs, yet can evolve gracefully to meet ISDN requirements, not yet set. More is said about this below and in Section 8.

The FCC Inquiry on ISDN

Recognizing that the integration of digital voice and data services will be the next stage in the evolution of communications, the FCC instituted a Notice of Inquiry on the ISDN, General Docket 83-841, in August 1983 (FCC, 1983). This is seen by some as a "first step towards developing a coordinated national policy for information systems" (MacNeice, 1983). The FCC asked for comments on the effect the ISDN(s) might have on information-services providers, telephone companies, and equipment providers. The document recounts the history of the domestic and international planning process and questions how U.S. procompetitive policies can be reconciled with the notion

of creating a centralized, integrated telecommunication system. A summary of the issues raised for comment can be found in Appendix B.1.

The FCC focused on "how the Commission can best complement existing efforts relating to the ISDN development and foster competition" (Telecommunications Reports, 1983a). The FCC is also evaluating its role in possible regulation of the ISDN since the ISDN(s) will ultimately affect the entire U.S. telecommunications market. It is clearly important that the implementation of the ISDN be in conformance not only with the FCC's competitive policies, but also with the Computer II decisions.

Among other ISDN issues of concern to the FCC are: the development of uniform standards to permit interconnection of national networks and the relationship between CCITT's planning efforts and U.S.-designated ISDN(s) (see Section 8); the extensive policy questions that will eventually arise in coordinating with foreign telecommunication administrations; and the national security aspects of the ISDN (a concern shared by the Department of Defense and the National Communications System; see Section 4.4).

A summary of comments received by the FCC appeared in the Telecommunications Reports of October 31, 1983 (Telecommunications Reports, 1983b). In essence the article states that "companies want procompetitive policies of U.S. reflected in global standards for ISDN's." The entire summary is reproduced, with permission, in Appendix B.2.

The first report of the FCC in response to the received comments was released on April 2, 1984. The concluding paragraphs are reproduced in Appendix B.3.

The FCC has extended the Inquiry, hoping to stimulate broader-based participation in the evolution of the ISDN by the potentially affected U.S. interests; to provide a "clearinghouse" for dissemination of information on ISDN developments; to provide a forum in which the Commission and its staff may be sensitized to ISDN ramifications that might not be readily apparent; and to highlight to the telecommunication industry the long-term ramifications of ISDN evolution.

4.2.3 Regulatory Standards

In general, the many different kinds of regulations can be divided into two categories. One is the traditional regulation that usually aims at specific industries and pursues essentially economic objectives (e.g., telephone regulations of the FCC, drug regulations of the FDA). The other is

the "new" kind of regulation that cuts across industry lines and pursues noneconomic objectives (e.g., health, safety, environmental issues). It is this latter kind of regulation that is often referred to as a "regulatory standard."

The traditional process of establishing regulatory standards by administrative agencies is known as rulemaking. This process is subject to the procedural requirements of the Administrative Procedures Act of 1946, plus any additional requirements imposed by the statute delegating the authority. Minimally, a proposed rule must be published in the Federal Register, and comments must be invited (and then considered) from all interested parties in the United States.

Direct Congressional legislation of regulatory standards has been almost nonexistent. The first legislation covering technological problems occurred in 1838 and was enacted as a result of steam boiler explosions. Over one hundred years later, in 1953, another safety standard was written into law, the Flammable Fabrics Act, built on two already existing Department of Commerce commercial standards. Today, Congress continues to recognize that it has neither the expertise nor the money to legislate effectively on such detailed matters.

Regulations, by nature, are strict and imposed by governments, never left completely to the play of the free market. Regulatory standards are not only a type of specific legislation, but are also a mandatory prescription of future conduct (Hamilton, 1983). Typically, they are narrow and detailed, and require complete familiarity with complex technological issues. Regulatory standards reflect social value judgments of public authorities for the "commonwealth" and relate to concerns of health and safety. As such, they almost always involve political as well as technological issues, and go well beyond purely economic issues. Congress usually delegates the power to formulate regulatory standards in very broad, nondirective terms, such as creating "reasonable standards," "standards that are in the public interest," or "standards that ensure safe and healthful working conditions." Consequently, Government agencies are viewed, with varying degrees of concern, as having "tremendous power . . . to shape not only individual firms but also entire industries through the exercise of this regulatory power." In reality, however, "while the agency in theory has broad discretionary power, in fact it is subject to political and other constraints that sharply restrict its power" (Hamilton, 1983).

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The regulatory standard is developed in situations where full information cannot be supplied to consumers briefly or easily or where the severity of the risk involved is great and the potential harm irreversible. These standards mandate that the manufacturing process, the product itself, or the service offered meet a minimum level of achievement. This is done by means of two basic types of standards, performance and specification. The performance standard requires that certain minimum goals be met without specifying the means the industry must use to comply. The specification standard spells out exactly what the company must do to conform to the regulation, mandating what technology must be used.

Those being regulated generally prefer the performance to the specification standard. Performance standards allow companies to find the most cost-effective way of complying with the standard and encourage technical innovation. Standards that stipulate what technology must be used, on the other hand, tend to discourage innovation. Either type of regulatory standard, however, is only as effective as its enforcement.

4.2.4 The Regulatory Use of Voluntary Standards

The tremendous increase in regulatory activity of the 70's and the public and private outcry against it have had two separate paradoxical consequences that can, nevertheless, both be viewed as contributing to the increasing use of voluntary standards by regulatory agencies. First, attempts to reduce the amount of regulation caused an increased complexity in the regulation-developing process. Second, reactions to attempts by the Federal Government to regulate the voluntary standards system served to strengthen the relationship between the voluntary standards system and regulatory agencies. This cooperation is essential because most regulatory standards applicable today are developed by the private sector, not by the Government, and these standards are made obligatory when they are incorporated into the regulation by "reference."

During the 70's, broad delegations of authority in newly developing technologies forced agencies to establish standards for the future that exceeded what then-current technology could meet. Countervailing activities within the Government—judicial, legislative, and executive—effectively made the development of regulatory standards (over the opposition of affected private interest) more cumbersome, time consuming, and difficult. These activities included:

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1. Courts increased the scope of judicial review, insisting that agencies demonstrate that they had given sensitive consideration to various points of view; that the agency's decision rests on an acceptable, factual base; that the agency's value judgments underlying the standards were rational and pervasive; and in a few cases granted additional procedural rights to private interests adversely affected by proposed regulatory standards--for example, oral hearings, the right to examine evidence, and the provision of cross-examination. These actions were based on concern that agencies might otherwise abuse the broad rulemaking powers they had been delegated to the injury of affected interests.

2. Congress increasingly hedged its grants of power to establish regulatory standards in both substantive and procedural ways. Legislative standards surrounding the delegation of legislative power become increasingly precise and narrow; new procedural rights were granted to affected interests by statute; and the legislative veto was applied to new grants of authority. In a few instances, Congress even substituted its own judgment for that of the agency by legislative enactment, reversing or changing regulatory standards adopted by the agency. These procedural and substantive requirements were imposed with increasing frequency in the 1970's and they have encouraged the judicialization of the process and further judicial review.

3. In both Carter and Reagan Administrations, a new development further complicated the process when the Executive Branch created a review process for new regulatory standards designed to ensure that the standards were consistent with the President's political and economic programs. This process, now embodied in E.O. 12291 "Federal Regulations" administered by the Presidential Task Force on Regulatory Relief, adds an entirely new level of review (after Hamilton, 1983).

As a result of these added complications to rulemaking, today's complaints about regulations, according to Hamilton, "are as often complaints of inefficiency as they are that agencies are promulgating bad [i.e., impractical, unreasonable, expensive, etc.] rules."

It might appear that the apparent efficiency of rulemaking has disappeared under the weight of judicial review, mandatory procedures imposed by statute, judicial order, internal review within the Executive Branch, and increasingly, by the formal or informal review of Congress itself. However, although the traditional model of Government establishment of regulatory standards has changed, the regulatory curve has flattened out but it has not changed direction. Because the changes have not been fundamental, they do not reflect a widespread rejection of the traditional patterns of Government regulation. The most fundamental of these changes involves the increasing use by regulatory agencies of private sector voluntary standards.

The second situation of the 70's was the extensive public and private examination of the voluntary consensus system (see Table 2 and Section 5) that served ultimately to publicize and increase general confidence in the quality, extent, and economic value of the voluntary system. The total scope of regulatory standards interests can be considered a subset of that of the voluntary system, which is extremely complex, widespread, and pervasive. In addition, no Government agency can hope to contain within itself the tremendous resources and expertise that are routinely found in U.S. standards committees. Neither can a Government agency involve in its work the numbers of individuals who contribute to the development and approval of an American National Standard. Although the American National Standards are implemented on a voluntary basis, this implementation is often extensive.

The regulatory "reference" of voluntary standards or their use in place of regulations has serious implications for the regulator and for the standards writer, if both activities are to maintain their own identities. In 1979, NBS published a 284-page report, "Regulatory Use of Standards: The Implications for Standards Writers." This report is directed to both regulators and standards writers. Although the relationship between the two activities remains—and must remain—dynamic, depending as it does upon a multitude of factors (e.g., technology, Congressional activities, national and international problems), this interrelationship will certainly affect the standards-writing activity.

It is in the standards writers' interest to write standards that would be suitable for regulatory use—or at least standards that are not likely to be misused by regulatory agencies. This requires that writers take agency needs and requirements into account, and provide complete documentation of why and how standards are written, for example by developing a rationale statement. Such a statement helps those who either comment on a standard-in-process or who review a developed standard for revision. In the particular case of a Government agency, the rationale statement would provide the needed information on why specific provisions were incorporated in the standard and why others were not. For further discussion on rationale statements see Mackay (1984).

At a minimum, the regulatory agency must make a thorough review of any standard that would be referenced in a regulation. This review would include all aspects of its development as well as its technical quality. More realistically, the agency should make its needs and criteria known to the

standardizing body prior to publication of the standard if possible, and this is best done by active participation in the standards development process.

4.3 The Federal Government and the Voluntary Standards System

The public sector-private sector debate of the 70's on standardization and the role of standards in serving the public was largely resolved by the publication of two policy documents referred to earlier in this report. The public sector produced OMB Circular A-119, "Federal Participation in the Voluntary Standards System." The private sector produced the "National Policy on Standards." (These two documents are subsequently referred to as the OMB Circular A-119 and NPS, respectively. They are reproduced in this report in Appendix C.)

The newcomer to the U.S. standards world, public or private, trying to understand the present position of the voluntary standards community in its relationship to U.S. Government standards developers, may find the content of these documents "obvious" and "logical." However, an appreciation of the fire out of which they were forged will help to clarify the extent of both past and present standards efforts. The discussion included below on the effect of these documents on international standardization is further developed in Section 7.

4.3.1 Government Activities

Congressional interest in standards as a means of regulating safety, performance, and environmental requirements of public interest law was high in the 70's. This interest leaned toward Federal management of voluntary standards activities in an effort to overcome the alleged negative aspects of standardization, but these efforts toward management proved not to be successful. In addition to Congress and OMB, the Federal Trade Commission (FTC) became involved in the efforts toward regulating voluntary standardization.

Congressional Action

Congressional action in 1968, House of Representative hearings on "The Effect Upon Small Business of Voluntary Industrial Standards," resulted in five recommendations, four of which proposed legislation for the Department of Commerce Office of Standards Policy to pass judgment on voluntary industrial

standards before promulgation, judging extent of consensus in development, and public interest.

These recommendations arose again in 1976 and 1977 when legislation to provide Federal regulation and oversight of the voluntary standards system was introduced in Congress. Congressional interest in this issue was triggered by standards-related suits alleging anticompetitive behavior. One such 1969 case dealt with a plywood standard which effectively excluded three-ply plywood from the marketplace. Although rare, this type of case prompted the introduction in the Senate of "The Voluntary Standards and Certification Act of 1976" (S.3555) and the "Voluntary Standards and Accreditation Act of 1977" (S.825). Both intended to correct anticompetitive and anti-innovative effects of, and charged lack of due process in, existing voluntary standards organization procedures, thereby fostering competition and consumer protection. Both bills had hearings by the Subcommittee on Antitrust and Monopoly (Senate Committee on the Judiciary), but neither passed out of Committee.

Although the efforts of the Senate bills to involve the Government in the regulation of voluntary standards methods did not succeed, many believe that much of the content of these bills accurately addressed the "real" world of standards development. Among the "Findings of Fact" set forth at the outset of S.3555 were the following:

1. Standardization of producer and consumer goods has become a necessity and an accepted means for marketing and purchasing products;

2. Standardization of products has an effect upon almost every line of commercial activity in the United States;

3. The expertise to develop sound technical standards lies more in the private sector than in the Government; and

4. The standardization process can facilitate trade, disseminate technology, improve communications between buyer and seller, and promote interchangeability.

These findings were on the positive side. On the negative side were the following findings:

1. The standardization process can have an adverse effect upon competition and consumers;

2. Within that process is considerable duplication and confusion;

3. The procedures for promulgating standards and for ensuring aggrieved parties due process, and the elimination of restraint of trade problems, are inadequate, with resultant potential for causing

deception to consumers and economic hardships for small business concerns; and

4. The lack of a uniform policy with respect to domestic standardization activities has impeded the effectiveness of participation by the United States in international standardization activities, which may have far-reaching consequences on balance of trade and balance of payments (Forman, 1981).

Several of these negative findings were eventually dealt with in OMB Circular A-119, in NPS, and in bylaw revisions of some of the voluntary standards organizations.

The four sections of the proposed 1977 bill, S.825, indicate the regulatory direction that Congressional activity was then taking:

Title I: to authorize FTC to promulgate procedural rules to improve consumer and small business involvement in private product standards development and certification, including a system for appealing product certification denials.

Title II: to establish an Institute of Standards and Accreditation within the National Bureau of Standards (NBS) to coordinate Federal participation in international standards-setting activities.

Title III: to establish criteria for Commerce Department accreditation of product certification, testing, and inspection laboratories.

Title IV: to establish a National Standards Management Board.

Federal Trade Commission Action

The basic objective of the Federal Trade Commission, established in 1914, is the maintenance of strongly competitive enterprises as the keystone of the American economic system, helping to keep competition in the United States both free and fair.

Consumer protection is the other main mission of FTC. The FTC's Bureau of Consumer Protection has been involved for the past decade (since 1974) in generating a proposed rule regarding the development and use of product standards and the related activity of product certification. (See "Title I" above.) This rulemaking effort by FTC relates to concern about the standardization process, given the growing tendency of voluntary standards to become obligatory by extensive use or reference, thereby acquiring the force of law.

On December 7, 1978, the Commission published a proposed rule in the Federal Register, "Trade Regulation Rule for Standards and Certification." The proposed rule addressed specific acts and practices that were stated to be both unfair methods of competition (section 6 of the rule) and unfair and

deceptive acts or practices (section 18 of the rule). The document addressed the development and use of product standards, the related activity of product certification, and the referencing of product standards and use of certification by sellers in the marketing of their product. The accompanying report was based on 29 "case studies" of purported abuse of the standards process—stating buyer misreliance and product exclusion. Although these 29 cases were a small number, "the standards organizations which are the subject of the complaints in these case studies represent a broad cross-section of the standards industry. Indeed, these organizations account for more than 50% of the 20,000 existent standards" (McCarey, 1983).

Participants in the FTC proceedings included representatives from: organizations that set, or certify compliance with, standards; industry members affected by those activities; Government agencies; academia (principally economists who have worked with standards issues); public interest groups; and various other organizations. However, in 1980, before the reaction report could be completed on this rule, Congress removed the authority of the Commission to issue trade regulation rules with respect to unfair acts or practices "with regard to the regulation of the development and utilization of the standards and certification activities." The Commission's authority to issue rules relating to unfair methods of competition relating to standards and certification was not affected.

On the basis of that authority, the FTC continued to gather material for its rulemaking record in order to decide what Commission action, if any, was needed with respect to standards on an industry-wide basis. This record was extended to cover comments solicited by FTC on the impact of OMB Circular A-119. The Commission, in particular, wanted to consider whether A-119 resolved any competitive problems of concern to the FTC.

Consequently, in the April 11, 1983 Federal Register, the FTC announced the availability of its final report on the 1978 rulemaking proceedings. The rulemaking record now consists of approximately 100,000 pages of documents and testimony. The Final Staff Report of April 1983 (FTC, 1983) is available from the Commission. The report states that the FTC staff abandoned the original rule proposal because it would impose burdens and costs in excess of whatever benefits were likely to be produced.

However, FTC is considering a revised rule on standards to remedy what it calls a procedural shortcoming in the standards system, identified as a failure to handle substantive complaints adequately. The strategic goal of

the 1978 rule had been to "influence decision making by prescribing the principles that would control the substantive decision-making process and the procedural manner in which those principles would be applied" (McCarey, 1983). The goal of the revised rule is to "force a decision within a reasonable amount of time and to require a sufficient memorialization of that decision so that antitrust enforcement, to either Government or private parties, would be facilitated" (McCarey, 1983).

The recommended rule is thus considerably narrower than the highly regulatory rule of 1978. Even so, the Director of the Bureau of Consumer Protection has stated in part that he has "serious doubts that an industry-wide rule is warranted" (Muris, 1983), and that "we should promulgate this rule only if it can provide incentives beyond those in existing law not to issue unreasonable standards" (FTC, 1983).

Relative to this, FTC recommended an additional period of public comment to determine whether standards-developing organizations have changed their practices as a result of several events that have occurred since the close of the record in January 1980. These events include the implementation of the GATT Standards Code (Section 6.3.3), the Supreme Court decision in the Hydrolevel Case (Section 4.1.4), and the issuance of OMB Circular A-119 (below).

Office of Management and Budget Action

The Office of Management and Budget (OMB) was established in 1970 and expanded in 1981. Its responsibilities include, in addition to Government-budget oversight, the development of regulatory reform proposals and the expansion of interagency coordination among Federal agencies. In 1981, OMB was given power to review and analyze all new and existing regulations. As part of its regulatory oversight responsibilites, OMB prepares reports on Government agencies for the President. These are often available to the public.

Of interest to this report is the OMB Circular A-119, "Federal Participation in the Development and Use of Voluntary Standards." The participation of Federal workers in the development and use of voluntary standards is certainly not new. Many U.S. Government agencies, especially NBS, have participated in voluntary consensus standards development from the earliest days of this century. In 1978, 113 organizational memberships in

ASTM were Federal Government groups. What is new is a written document that provides uniform policy and administrative guidance to Federal agencies. The three major policy items are:

1. reliance on the use of voluntary standards, domestic and international, for procurement and regulatory activity, whenever feasible;

2. participation in voluntary standards bodies; and

3. coordination of agency participation in voluntary standards bodies.

The OMB Circular A-119 is a definite step forward in the shaping of Federal policy with respect to the use of the voluntary consensus system. The 6-year history of the Circular's development, 1976-1982, serves to record the changes that have occurred in the regulatory "climate" of the United States (see also Table 2, Section 3.4).

In 1976, an Interagency Committee on Standards Policy (ICSP) was formed, consisting of representatives from 22 Government agencies, to develop policy statements on uniform and increased Government participation in and support of private voluntary standards activities. (See Section 4.3.3.) The recommendations developed by ICSP in July 1976 became the basis for the OMB Circular A-119: 1976 (Draft), 1978 (Proposed), 1980 (Issued), and 1982 (Revised).

The drafts of this document, and even its first (1980) publication, contained regulatory-type provisions that were seemingly accepted by most of the voluntary system. In comparison with regulation of the voluntary system, the voluntary standards community perhaps viewed the OMB Circular as a "lesser evil." In 1981, the Circular was reviewed, only one year after its issue, "to ascertain that it did not impose unnecessary burdensome or counter-productive requirements on the public or private sectors" (Federal Register, 1982). Subsequently, the 1982 revision incorporated four main changes, three of which effectively removed all "regulatory" requirements, leaving the voluntary system to police itself. These changes were:

1. elimination of the "due process" criteria and the requirements that voluntary standards bodies adhere to those criteria as a prerequisite to Federal participation in them;

2. elimination of the provisions relating to the establishment of a Government-sponsored voluntary dispute-resolution service; and

3. elimination of requirements that called upon the Secretary of Commerce to maintain a list of certified voluntary standard bodies and to issue implementing procedures for agency use.

The fourth change expanded the scope of the Circular to encourage Federal use of voluntary standards for regulation and other purposes--not just for procurement usage.

A fifth change that has occurred concerns the earlier provisions that required agencies to coordinate their views and to express a single Federal position in all instances where two or more agencies participated in standards activity. Although OMB continues to believe that "agencies should endeavor to coordinate their views and present single Federal positions in matters of paramount importance," the requirements were eliminated except for "matters of paramount importance."

The main body of the Circular gives guidelines for its implementation. These provisions are intended for internal management purposes only, and in particular are not intended to "1) create delay in the administrative process, 2) provide new grounds for judicial review, or 3) create legal rights enforceable against agencies or their officers" (Federal Register, 1982).

Implementation of this Circular is expected to aid both private sector standards organizations and Government agencies, if certain unstated conditions are true. Among these are premises that both public and private sectors are themselves internally well coordinated, that the relationships existing in each sector are efficient and appropriate, and that the principal actors in each are competent and working to the same ends. Under these conditions, Circular implementation will ideally:

1. result in reduced cost to the Government in developing and maintaining standards for products, systems, and services, particularly as a consequence of limiting redundancy and overlap in U.S. standards activities;

2. provide a way to make Government influence and needs felt before and during voluntary standards development. These standards will then be acceptable to those agencies adopting them in regulations;

3. improve the ability of the United States to cope with the trade activities of other nations that have standards systems supported, often fully, by their governments; and

4. help assure the use of open procedures (especially adequate notice and opportunity to comment) required by the GATT Standards Code to prevent the creation of product standards that discriminate against important competition.

The Circular assigns the Department of Commerce (DOC) the general responsibility of coordinating and fostering executive branch implementation of the policy. However, the Head of each Departmental unit that is engaged in voluntary standards or is otherwise affected by the Circular is responsible

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for guideline implementation within that unit, and for reporting to the Secretary of Commerce on the status of agency interaction with voluntary standards bodies.

An example of the efforts made to comply with OMB Circular A-119 is the DOC Departmental Committee on Standards Policy, formed in May 1983, established to advise the Director of NBS and through him, the Secretary of Commerce, on the implementation of A-119 within DOC. The twofold purpose of the Committee is to facilitate the effective participation by the Department of Commerce in voluntary domestic and international standards activities and to promote the development of uniform policies among operating units of the Department participating in these activities. The Committee will, in addition, strengthen coordination of the various standards activities among the various DOC operating units.

4.3.2 Private-Sector Activities: The National Policy on Standards for the United States

For more than a century, from the mid 1860's to the mid 1970's, the voluntary standards system of the United States developed successfully with no stated unified national position and no written policy. This success was in effect a tribute to the U.S. democratic approach to decision making. Because the pluralistic and complicated standards process that evolved was directly related to an understanding of the basic constitutional, institutional, and economic U.S. structure, there was, effectively, an unwritten de facto policy mirroring the democratic system, generally well understood by the participants.

What then precipitated the need for a national policy on standards in the late 70's? The reasons reflect, minimally: the attempts by Government to regulate the system; the exponential growth of participation in U.S. standardization; the expansion of the standards world to include international participation in the U.S. national arena; and the trend of regulatory activity to be based on appropriately developed consensus standards. Although the de facto U.S. policy had been understood by the participants who had worked, in some cases for decades, in standards development, a policy that would pull together the concepts of the de facto policy was now needed to allow the thousands of newcomers, in Government and industry, to use the system with confidence and understanding. In addition, the hundreds of international visitors, who both observed the system and participated in standards

development, did not understand the system well. This understanding was largely dependent upon the individual's governmental background. Interpreters have stated that visitors from Russia, for example, did not clearly understand the U.S. meaning of words like "voluntary" and "consensus."

The need for a national standards policy had frequently been expressed in the United States, although definitive action was not taken until 1978. In 1927, the Report of the Standardization Survey Committee (see Section 3.2) stated, "The results of this survey indicate the need of a unified purpose if the maximum benefit is to be derived from the sums now being spent by industry on standardization." In 1975, when the yearly "sums" were approaching the billion dollar mark, ASTM's report on "The Voluntary Standards System of the United States of America" pointed out, "One weakness of the voluntary standards system is the lack of a national policy on standardization . . . There appears to be little appreciation for the tremendous investment of manpower that the private sector has been making in the development of standards." During the 50 years separating these reports, the impact of standards expanded to virtually all segments of our society, and more and more people became involved.

In late 1976, two Government documents were issued, each lending support to the need for a national policy: the above mentioned draft OMB Circular A-119, and the Department of Defense (DOD) Directive 4120.20.

The Department of Defense expressed tangible support for a national standards program when it issued its Instruction 4120.20, "Development and Use of Non-government Specifications and Standards," dated December 8, 1976. Six years preceding this, DOD had already taken a significant move when it petitioned an ASTM committee to develop a "commonality program," permitting DOD to adopt many ASTM specifications (on steel). The intent of the 1976 directive was to strengthen DOD participation in voluntary standards writing groups and to increase DOD adoption of the standards of these groups. The DOD instruction, a response to the proposed Office of Management and Budget Circular, preceded the first draft of A-119 in the Federal Register by three weeks.

Before 1977 there had been "no single, agreed upon forum where the system, both in and out of Government, can agree on, or . . . even discuss, such matters" (Cavanaugh, 1977). Therefore, in 1977, ANSI established an independent 30-member body, the National Standards Policy Advisory Committee

(NSPAC). ANSI established NSPAC as a public service, and the committee was free from any policy direction by ANSI. The thirty members of NSPAC included representatives of Government, organized labor, public interest groups, trade associations, industry, professional societies, standards writing bodies, testing laboratories, and consumers. The goal of this group was to develop a national policy for voluntary (not legislative) standards acceptance that would establish a cooperative relationship between the Government and the private sector to ensure that the nation's needs for standards would be competently, economically, and equitably met, using due-process principles.

This immense task was made easier by the existence of studies, reports and documents, from both the public and private sectors (see Table 2). They became the "stepping stones" upon which the developers of the NPS could walk.

The National Policy on Standards, together with its accompanying Recommended Implementation Plan, was issued in 1979. (Only the policy is reproduced in Appendix C of this report.) Its stated objectives are:

1. To provide policies with respect to both Government and private initiation, development, use, and maintenance of national standards for products, systems, and services; and

2. To provide a framework for the efficient organization and management of both Government and private resources to ensure that the United States' national standards needs are competently and economically met, on a timely basis, under generally recognized principles of due process.

The policy, directed to all private and public sectors who develop or use national standards or are involved in international efforts, stresses the overall importance of cooperation between the two sectors. The characteristics expected to be part of national standards writing activities, such as openness, consensus, and balance, are delineated.

Echoing OMB Circular A-119, the NPS emphasizes the need to minimize duplication of standards efforts. The NPS requires the establishment of two standards-activity coordinating centers, one for the Government and one for the private sector. These roles are fulfilled by NBS and ANSI, respectively.

In general, the NPS conditions for the Government sector are met by OMB Circular A-119. In addition, the NPS provides the framework necessary for fulfillment of the GATT Standards Code that, for ideal implementation, requires a cooperative relationship between the Federal Government and the private sector in international standards activities.

4.3.3 The National Bureau of Standards

Among the many Governmental organizations whose members are involved in standards writing both within the Government and in the voluntary systems, the NBS is the most prolific, by far. Created by an Act of Congress in 1901, NBS is the nation's measurement laboratory in the physical and engineering sciences. It is not a regulatory agency, but rather a laboratory used by industry, academia, and Government alike as an independent source of technical information and advice. Its purpose is to help ensure the compatibility of measurement standards needed by industry, consumers, scientists, and Government.

The Bureau's programs are directed toward reducing or removing technical barriers that impede the prompt introduction or exploitation of new technologies. To achieve this end, NBS works to improve measurement methods, data, and standardization in such areas as semi-conductor electronics, materials science, automated manufacturing, and chemical engineering. The structure of the NBS organizational chart in Figure 5 indicates the importance to NBS of research and technical and scientific services.

The National Measurement Laboratory ensures that physical and chemical measurements within the United States can be traced to a consistent set of standards, reference methods and reference materials that are also compatible with those used to regulate international trade.

The National Engineering Laboratory conducts research in engineering and applied sciences, develops engineering data, and provides improved measurement techniques to the engineering community. The laboratory's research covers many disciplines including electrical, chemical, civil, and mechanical engineering and applied mathematics.

The Institute for Computer Sciences and Technology develops standards for computers and networks, performs computer and computer networking research, and provides scientific and technical advisory services to Government agencies (see Section 4.4.1).

The Office of Product Standards Policy, recently formed in NBS, is discussed below. Standards activities support the overall NBS goal, which is to strengthen and advance the nation's science and technology and to facilitate their effective application for public benefit.

U.S. DEPARTMENT OF COMMERCE
National Bureau of Standards

DIRECTOR

DEPUTY DIRECTOR

Office of the Legal Advisor
Office of Congressional Affairs
Associate Director for International
  Affairs

ASSOCIATE DIRECTOR FOR PROGRAMS, BUDGET & FINANCE

Program Office
Budget Office
Office of the Comptroller
Planning Office

OFFICE OF PRODUCT STANDARDS POLICY

OFFICE OF THE DIRECTOR NBS/BOULDER LABORATORIES

DIRECTOR OF ADMINISTRATION

EEO Support	Plant
Library	Facilities Services
Technical Information & Publications	Occupational Health & Safety
Public Information	Personnel
Management Systems	Office Management

NATIONAL MEASUREMENT LABORATORY

Center for Absolute Physical Quantities
Center for Radiation Research
Center for Chemical Physics
Center for Analytical Chemistry
Center for Materials Science

NATIONAL ENGINEERING LABORATORY

Center for Applied Mathematics
Center for Electronics & Electrical
  Engineering
Center for Manufacturing Engineering
Center for Building Technology
Center for Fire Research
Center for Consumer Product Technology
Center for Chemical Engineering

INSTITUTE FOR COMPUTER SCIENCES & TECHNOLOGY

Center for Programming
  Science & Technology
Center for Computer Systems
  Engineering

Figure 5. The organization of the National Bureau of Standards (NBS).

Standards Work by NBS

In addition to development of standards within NBS and in intergovernmental standards groups, NBS has a long history of extensive participation in voluntary standards organizations, both national and international. This activity has been further encouraged by OMB Circular A-119. In 1983, 446 (or 28%) of NBS' professional, scientific, and technical staff participated in standards activities of 87 standards organizations, national and international. These 446 NBS staff members served on 989 separate standards committees, chairing 159 (11%) of them. The three standards organizations with largest NBS participation were: ASTM (724), ANSI-accredited committees (220), and ISO (64) (NBS, 1984a). This broad support of voluntary standards activities provides NBS with an effective opportunity to disseminate, in a timely manner, the results of its research conducted in its role as the Federal measurement laboratory in engineering and in the physical sciences. In turn, NBS personnel find a mechanism for interacting with their counterparts in industry and academia, both nationally and internationally.

The Office of Product Standards Policy (OPSP)

The Office of Product Standards Policy (OPSP) was transferred in 1982 within the Department of Commerce to the Office of the Director, NBS. This office, through its four programs depicted in Figure 6, now serves as the focal point for NBS standardization activities. It also operates as the Government Sector Standards Coordinating Center described in the National Policy on Standards. As such, OPSP is in a position to provide leadership in the development and implementation of unified, coherent Federal standardization policies. This office also cooperates with private sector organizations to ensure that the nation's standards needs are effectively and promptly met.

Through its Standards Code and Information Program, OPSP has responsibility for the NBS standards-information center, established in 1965 as the national repository of standards-related information. Known as the National Center for Standards and Certification Information (NCSCI), it aims to "respond to the needs of Government, industry, and the general public for information on domestic and foreign standards, regulations, certification, and standards-related activities" (NBS, 1983). The NCSCI fulfills these objectives by storing and disseminating standards information, and also serves

OFFICE OF PRODUCT STANDARDS POLICY

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│Code &    │  │Accreditation│   │Measures  │    │Management│
│Information│ │          │      │          │    │          │
└──────────┘  └──────────┘      └──────────┘    └──────────┘
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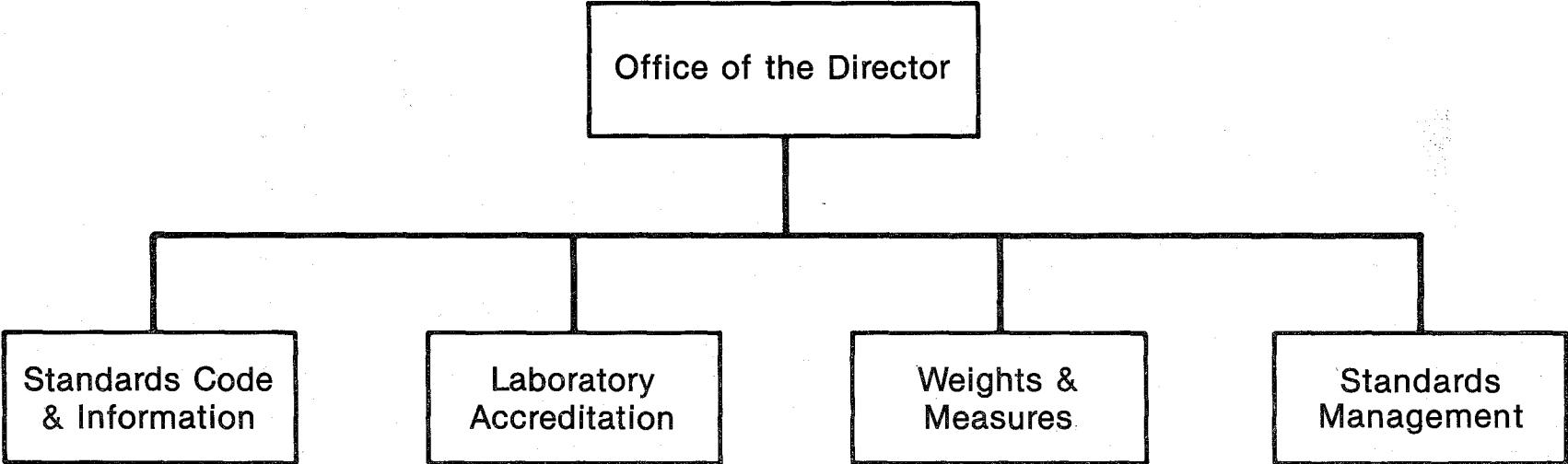
Figure 6. The organization of the Office of Product Standards Policy (OPSP) in the National Bureau of Standards (NBS).

as the U.S. focal point for inquiries related to GATT (see Section 6.3.3) and ISONET (see below).

The NCSCI has information on more than 240,000 standards (also specifications, regulations, etc.). The reference collection encompasses U.S. industrial, national, and Federal standards, international and regional standards, and foreign national standards. NCSCI answers over 5,000 individual inquiries annually on the source, availability, and general substance of standards.

NCSCI has developed computerized data bases for rapid retrieval of information on 32,000 U.S. voluntary standards. In addition, these standards are available on microfilm for reference use in NCSCI. Most of these microfilmed standards are available commercially; NCSCI does not provide copies of standards, but only information about them or on-site access to them.

The Standards Code and Information Program also fulfills assigned U.S responsibilities in accordance with two international agreements: the ISO Information Network (ISONET) and the GATT Agreement on Technical Barriers to Trade (the so-called "Standards Code"). An information newsletter, "tbt news", is published by the Standards Code and Information Program approximately six times a year and features information on services available from Federal agencies, including notifications of proposed foreign regulations and bilateral discussions of standards-related trade problems with other countries, along with news items and descriptions of Government agencies participating in the implementation of the GATT Standards Code under the U.S. Trade Agreements Act of 1979.

The first of the international agreements mentioned above, ISONET, involves a worldwide network linking the Information Center of the ISO Central Secretariat in Geneva with the corresponding centers of the 56 Members (including the NBS center in the United States). This network, started in 1969, provides the framework and procedures to facilitate the international exchange of information about standards and technical requirements. It is a completely decentralized operation. Each member is responsible for collecting and indexing its own information and for making it available to others in the ISO-approved exchange format. This network permits a small country to establish a relatively low-cost system for indexing and retrieving standards information that might otherwise be prohibitively expensive. ISONET was designed to promote international trade by providing rapid access to reliable

information. The reader interested in more information about ISONET is referred to the 1980 NBS Special Publication 579 (NBS, 1980).

Although ISONET was created independent of GATT considerations, these already-established centers are effective media for implementing the "Inquiry Points" required by GATT. These inquiry points are required to provide for the GATT Secretariat in Geneva notification of proposed standards and technical regulations which might significantly affect trade. Twenty-one of the 37 GATT signatories have chosen to establish their inquiry points within their national ISONET member.

As the GATT "inquiry point", NBS/NCSCI provides the following services:

1. Notifies the GATT Secretariat of proposed U.S. regulations potentially affecting trade. On request, full text of Federal Register notices of these proposed regulations are made available to the other 36 signatories to the GATT Standards Code.

2. Receives, disseminates, and maintains information on proposed foreign regulations (including translations when available) that might affect U.S. trade opportunities with those same countries. (All foreign notifications are now published in the Commerce Business Daily, the ANSI Standards Action, the ISO Bulletin, and other selected publications.)

3. Maintains a 24-hour information "hotline" for notification information, updated weekly (301/921-3200).

4. Coordinates a shared-fee translation service.

In addition, the Standards Code and Information Program provides mandated technical office services for issues related to foreign and international standardization activities. These services include assessment of the effects of foreign standards on U.S. trade, monitoring of U.S. participation in international standardization activities, and technical analysis in support of U.S. trade negotiations.

Another OPSP program of relevance to this report is that of Standards Management. In addition to the management of U.S. participation in the International Organization of Legal Metrology (whose aim is the harmonization of legal measurement requirements), this program:

1. Administers the Department of Commerce Voluntary Product Standards Program;

2. Supports OPSP Federal standards policy and coordination responsibilities by providing the secretariat for the Interagency Committee on Standards Policy and assisting agencies in developing their standards programs;

3. Supports OPSP responsibility concerned with liaison with U.S., foreign, national and international standards bodies; and

4. Collects and disseminates information on NBS staff participation in outside standards organizations.

The Interagency Committee on Standards Policy (ICSP) (Section 4.3.1) has been reactivated under the chairmanship of OPSP. A task group of the ICSP has developed guidelines for Federal participation in international standards activities. (Table 2, Section 3, lists the titles of these guidelines.) This group took into consideration the ANSI procedures for U.S. technical advisory groups (TAGS) for ISO and IEC activity (see Section 7.5). For further information see Federal Register (1984).

4.4 Federal Computer and Telecommunication Standards

The Federal Government produces standards that are used in Government procurement and defense activities, and by other non-Federal Government agencies. Of the approximately 50,000 Government standards, 40,000 are DOD standards and 5,000 are used by General Services Administration (GSA) for procurement purposes. These standards often reference voluntary consensus standards as do regulations. For further discussion on the use of voluntary standards for Government standards, see Section 5.1.2 that deals with ANSI and the Federal Government.

Two Federal standards-development programs are of particular interest to the automatic data processing and telecommunication communities—the Federal Information Processing Standards (FIPS) Program and the Federal Telecommunication Standards Program (FTSP). This section discusses each of these Federal standards programs and the Government agencies responsible for them.

4.4.1 NBS/ICST and Federal Information Processing Standards

To develop a meaningful perspective on the functioning of the FIPS Program discussed below, it is helpful to consider the role of the Government as a user of computers. Since the beginning of the computer era, the Government has been the largest single U.S. user of computers. In the early 1950's, the Government controlled nearly 100% of the computers used. As computers proliferated in the private sector, however, this percentage decreased to 8.7% in 1965 and to 4.1% in 1975 (Burns and Radack, 1977). Although the Government share of the computer market has fallen from about 60%

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in 1962 to less than 10% in 1983, the Government continues to buy more of a rapidly expanding market. Today, the Government operates 18,000 medium and large computers at 4,500 sites. By 1990, there will be an estimated 25,000 large computers, and 250,000 to 500,000 microcomputers in the Government (New York Times, 1983).

In the early 60's, as widespread use of computer systems developed in the Government, problems of incompatibility between systems and within systems became critical; efforts to solve these problems were expensive. In response, Congress enacted the Brooks Act in 1965 (PL 89-306) as an amendment to Title I of the Federal Property and Administration Services Act of 1949. The purpose of PL 89-306 was "to provide for the economic and efficient purchase, lease, maintenance, operation, and utilization of automatic data processing equipment by Federal departments and agencies". To achieve this goal, three responsibilities were assigned to the Secretary of Commerce (and through him to NBS):

1. to provide agencies, and the Administration of General Services, with scientific and technological advisory services relating to automatic data processing and related systems,

2. to make appropriate recommendations to the President relating to the establishment of uniform Federal automatic data processing standards, and

3. to undertake the necessary research in the sciences and technologies of automatic data processing computers and related systems as may be required (Brooks Act, 1965).

More is said below about these NBS responsibilities, especially point No. 2 on standards.

According to the Brooks Act, the Office of Management and Budget was assigned responsibility for exercising fiscal and policy control (transferred to the Secretary of Commerce in 1973). Therefore, in 1966, the OMB predecessor, the Bureau of the Budget, issued a Policy Guidance Letter to the Secretary of Commerce implementing PL 89-306.

The Institute for Computer Sciences and Technology (ICST)

In response to these new responsibilities, NBS consolidated several units in 1966 to form the nucleus of what is now called the Institute for Computer Sciences and Technology (ICST). Before this time, NBS had been actively involved in the development of pattern recognition techniques, optical scanning devices, time-sharing, multiprogramming and multiprocessing

capabilities, and numerous computer applications. The advisory services and research required by points 1 and 3 of Brooks Act responsibilities have since been carried out in ICST.

The ICST (see Figure 7) works in the field of automatic data processing (ADP) and is a center of technical expertise in information technology. While ICST focuses primarily on helping the Federal government make effective use of computers and information technology, ICST products, services, and technical support are used by the private sector and all levels of government as well.

The major activities of ICST are:

1. determining requirements for and participating in the development of national and international voluntary industry standards for computer products and services;

2. developing guidelines, technology forecasts, and other products to aid in the effective management and use of computers;

3. disseminating and exchanging information with Federal, State and local governments, industry, professional, and research organizations on computer use and standards needs;

4. providing technical support for the development of government policies in information technology;

5. providing direct technical assistance to Federal agencies on a cost reimbursable basis; and

6. carrying out applied research and development (NBS, 1984b).

Based on these activities, the principal products and services are:

1. advice and information shared with Federal, State, and local government computer users and with industry manufacturers and users;

2. forecasts of information processing technology to guide users in planning for the use of new technology;

3. analyses of the uses of information technology, highlighting successes that can be transferred and common pitfalls to be avoided;

4. test methods, description techniques, design specifications, and performance measures to provide the technical base for standards and information products;

5. guidance for managers emphasizing cost effective and well-defined activities that will improve the use of computers; and

6. standards, when they are needed, to meet user needs for off-the-shelf products that are compatible and economical (NBS, 1984b).

The ICST and Standards Development

The ICST's primary purpose since 1968 has been to develop Federal Information Processing Standards (FIPS) for the use of the Federal Government, still the largest U.S. user of computers. To date, there are more than 100

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**INSTITUTE FOR COMPUTER SCIENCES
AND TECHNOLOGY**

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   │   Programming    │              │ Computer Systems │
   │Science & Technology│            │   Engineering    │
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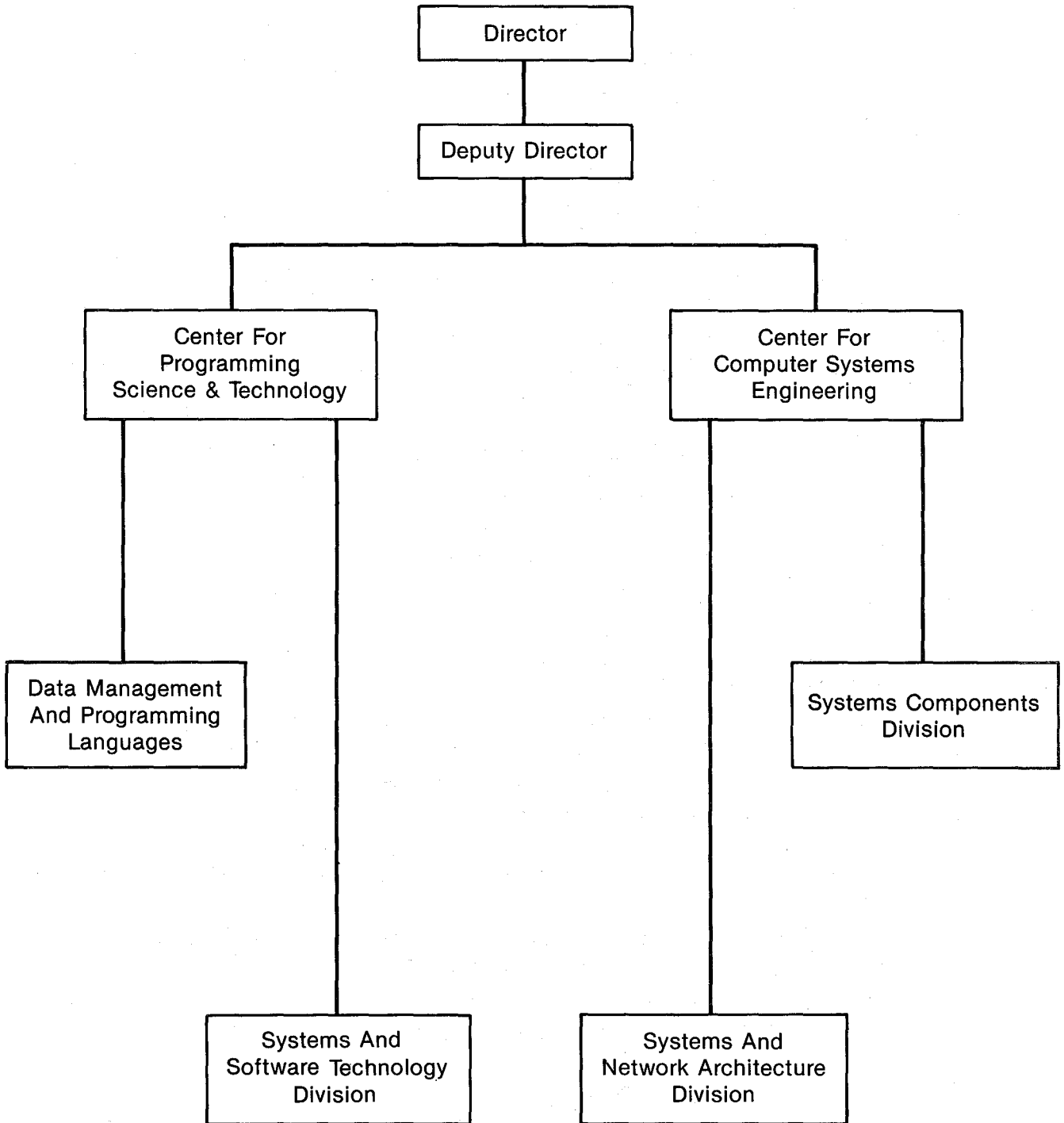
Figure 7. The organization of the Institute for Computer Sciences and
Technology (ICST) in the National Bureau of Standards (NBS).

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FIPS publications (FIPS PUBS) available, including standards and guidelines. These are listed in NBS (1984b). This list is obtainable from ICST (301-921-2834). The FIPS PUBS may be purchased from the National Technical Information Service (NTIS) (703-487-4650).

The general goals of the FIPS Program are to develop, issue, and maintain standards and guidelines that will help Federal agency managers use information technology effectively in their programs, without stifling the development or application of new technology.

Specific goals of the FIPS Program are:

1. to improve the life-cycle efficiency and effectiveness of Federal information technology resources;

2. to facilitate the competitive and economic procurement of systems, components, and services;

3. to improve the portability of data, software, and technical skills across systems;

4. to protect systems and networks against unauthorized access, manipulation, or abuse;

5. to reduce waste, errors, and unnecessary duplication in the application and use of systems; and

6. to increase the productivity of the Federal workforce (NBS, 1984b).

The ICST program for standards development is revised annually. When possible, ICST develops standards in conjunction with voluntary industry standards groups, a process that is mutually beneficial to both industry and government. When Federal needs for standards or for timely action are not being met by voluntary activities, ICST may undertake independent action.

The ICST work in ADP standards has now led to active support of U.S. industry in the voluntary standards process, both nationally and internationally. The following discussion of the shift in emphasis in ICST standards work from FIPS for the Federal Government, to FIPS for the Federal Government _and_ other U.S. users as well, is borrowed generously from an ICST document (ICST, 1984). The reader interested in more detailed information on either the national or international standards efforts is referred to ICST.

Any organization, including the Federal Government, may establish its own ADP standards, and, if it is large enough, can find vendors to supply products to meet its specifications. To establish its own standards, the organization becomes responsible for designing, specifying, implementing, and improving the product with its own resources. These specially engineered products are extremely costly from the standpoint of the organization buying the products

and may be lower-profit, less-preferred products from the standpoint of the computer vendor.

In contrast, if the buying market is aggregated, and specifications are developed that suit the needs of the aggregated market, "off-the-shelf," commercial products are developed, maintained, and improved by the vendors. Market aggregation can be achieved through the voluntary standardization process.

It has become clear to ICST that "off-the-shelfness" cannot be achieved by developing standards only within the Federal Government, nor can the best interests of the U.S. industry be served. Therefore, ICST is now very active in voluntary standards committees, often the technical representative of computer users in the committees. By providing such user-oriented technical support, in conjunction with that offered by manufacturers, ICST considers that it can often achieve one of its primary objectives, "the definition of standards leading to off-the-shelf products for Government agencies as well as for the private sector ADP users" (ICST, 1984). Often, the voluntary standard is also published as a FIP standard by ICST.

Representatives from ICST are involved in international standardization activity as well, in recognition of the importance of international competition in the computer industry. In the words of ICST, this is done

> by developing specifications resulting in international standards which can be implemented in our country products and sold in any country. In addition, a large segment of the U.S. industry that does not manufacture computers depends on the standards to increase its own productivity and to save costs through interconnection and the sharing of expensive computing and information resources. This includes much of our major exporting industries such as aircraft and banking . . . [ICST] international standardization activity is currently intense in the program areas of local area networks, high speed networks, data interchange, and interfaces (ICST, 1984).

4.4.2 NCS and Federal Telecommunication Standards (FTS)

An element of the overall General Services Administration's Federal Standardization Program is the Federal Telecommunication Standards Program (FTSP). The FTSP was mandated in 1972 and is managed by the National Communications Systems (NCS). This section provides background material on NCS, and its function as manager of the FTSP.

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The National Communications System (NCS)

The National Communications System (NCS) was established in 1963 by Presidential Memorandum to provide necessary communications for the Federal Government under all conditions ranging from the normal situation to national emergencies and international crises (including nuclear attack). The role of NCS was recently strengthened by Executive Order (E.O.) 12472, dated April 3, 1984, which supersedes the 1963 Memorandum.

The NCS, according to the 1984 Executive Order, is composed of: an Executive Director, who is the Secretary of Defense; a Committee of Principals (and their telecommunication network assets) consisting of 18 Executive Branch agencies and 4 independent organizations (including the FCC); and a Manager.

The Federal Telecommunications Standards Program

The function of the Manager, NCS, of most interest in this report, is that of Manager of the FTSP. As stated in E.O. 12472, the Manager of the NCS shall:

> pursuant to the Federal Standardization Program of the General Services Administration, and in consultation with other appropriate entities of the Federal government including the NCS Committee of Principals, manage the Federal Telecommunications Standards Program, ensuring wherever feasible that existing or evolving industry, national, and international standards are used as the basis for Federal telecommunications standards (Executive Order 12472, 1984).

The objectives of the FTSP are to:

1. identify and remove, through standardization, as many of the technical impediments to interoperability of functionally similar Federal Government telecommunications networks as are economically feasible without significantly compromising the performance or operational integrity of these networks;

2. identify and develop, in concert with the National Bureau of Standards (NBS), those standards dealing with telecommunication functions, so as to achieve a compatible and efficient interface between ADP and telecommunications;

3. eliminate unnecessary differences between Federal standards and corresponding international, national, and U.S. industry standards in telecommunications; and

4. improve the cohesiveness and effectiveness of the Federal telecommunication community's participation in the standards development activities of the various national and international standardization bodies (after NCS, 1983).

NCS, in planning and executing the FTSP, relies heavily on the advice and resources of an interagency committee called the Federal Telecommunication Standards Committee (FTSC). This committee, which has met since 1972, is composed of representatives of 15 Government departments and agencies.

FTS Development Process

The discussion of the FTSP standardization process as discussed below has been taken largely from NCS (1983).

Specific proposals for the initiation of a project to develop a Federal telecommunication standard are presented to the FTSC and NCS management in a document called a Statement of Requirement (SOR). The SOR describes the need the proposed standard would satisfy, the relevance of satisfying these needs to the removal or avoidance of interoperability impediment to Federal telecommunication systems, and any related national and international standards development efforts which would enhance the universality of the proposed standard. An SOR can theoretically originate in any Federal department or agency. In practice, most are originated by agencies represented on the FTSC or by the NCS staff. Once the SOR for a proposed standard development project is approved by FTSC and NCS management, the standards development process begins.

The first step is the selection of an appropriate development method and activity by the NCS management (with FTSC advice). Since a major objective of the Federal Telecommunication Standards Program is the elimination of unnecessary differences between Federal standards and related national and international standards, development of the required standard through well-focused joint undertakings with appropriate industry, national, and international standardization groups obviously ranks high in the choice of a development method.

In those exceptional instances where national and international standards development groups are unable or unwilling to undertake the timely development of a standard which could be adapted to satisfy the requirements of an SOR, the NCS and FTSC do not hesitate to develop the required standard on a unilateral basis. In the latter instances, the development activity may be either an FTSC technical subcommittee (e.g., FTSC Fiber Optics Task Group) or a single Federal agency (e.g., NTIA/ITS).

NCS management, with the advice of the FTSC, determines when the development of a proposed Federal telecommunication standard has reached the

point where it is ready for formal coordination with Federal agencies and for public comment. When the comments of Federal agencies and the general public on the proposed standard have been resolved to the satisfaction of the FTSC and NCS management, the standard is forwarded through the Executive Agent, NCS, to the Office of Science and Technology Policy (OSTP) for final policy-level approval.

As of June 1983, 23 Federal Telecommunication Standards (available from GSA) and 36 NCS Technical Information Bulletins had been published. Several of these standards were published as "joint" Federal Information Processing and Federal Telecommunication Standards applicable to both the computer and communication communities of the Government. For example, in 1983, the "Interface Between Data Terminal Equipment (DTE) and Data Circuit Terminating Equipment (DCE) for Operation with Packet Switched Data Communications Networks" was published as FIPS 100/Federal Standard 1041.

Participation of NCS in Standards Organizations

The standards needed to promote the interoperability of the various national telecommunication networks worldwide, including, for example, ISDN, are the same standards needed to ensure the interoperability of the various Federal telecommunication networks in the United States. Accordingly, "the NCS, in managing the FTSP, must continue to exploit the similarities in objectives by pro-active participation in selected national and international standards development groups" (NCS, 1983). To the extent that the standards developed by these organizations satisfy--or can be adapted to satisfy--the NCS operability objectives in a timely way, they are adopted as mandatory Federal standards. This step is necessary to help ensure that "all Federal agencies are aware of and use the applicable interoperability-determinant portions of what would otherwise be a purely voluntary standard" (NCS, 1983).

Certain NCS standardizations requirements are outside the scope of the current interoperability activity of the national and international standards organizations. One such category, for example, is the protection of telecommunication facilities from disabling damage by the effects of electromagnetic pulse (EMP) originating from high-altitude nuclear detonations. According to NCS, this is the type of standard in which "the Government must take the lead . . ." (NCS, 1983). The NCS is presently planning to develop a family of facility-oriented EMP standards, and then

hopes to influence the industry that develops communications and computer equipment to adhere to these standards.

5. ANSI's ROLE IN THE U.S. VOLUNTARY CONSENSUS STANDARDS SYSTEM

The community encompassing the U.S. voluntary standards system has already produced thousands of national standards and possibly hundreds of thousands of company and industry standards. This activity is largely decentralized. However, the establishment of a full consensus standard as an American National Standard is the responsibility of the American National Standards Institute (ANSI). The mission of ANSI is to "serve its constituencies--Government, industry, consumers, professional societies, associations--all those who subscribe to the concept that the standards needs of our nation are best served by the voluntary consensus standards system that bows to the dictates of none and listens and responds to the needs of all" (Rankine, 1983).

The year of ANSI's founding, 1918, was a year of challenge in the U.S. standards world. The problem then resulted from too rapid an increase in standards by independent organizations, with resultant overlap and confusion. The decade of the 80's is another time of rapid growth and change in the U.S. standards community, and in the standards community worldwide. Today's challenge stems from the fact that technology's rapid development is based on topics that are vastly more complicated than ever before, and the interdisciplinary nature of these technologies has resulted in a new period of potential overlap in the standards world. This time the stakes are much higher, because many of today's standards are already being factored into the planning of tomorrow's world.

This section of the report discusses ANSI's twofold role as coordinator of national standards activities and approver of American National Standards. Special mention is made of ANSI's extension of its coordination and planning services to emerging technologies, such as telecommunications and industrial automation, to prevent duplication. The other major responsibility of ANSI as the coordinator and manager of the United States participation in international, nontreaty standards organizations, is only touched on in this section; it is dealt with in Section 7.5.

5.1 What is ANSI?

The question "What is ANSI?" is of particular significance in the 1980's for several reasons. The activity of the 70's in the standards community, as discussed in Section 4, has caused ANSI to become even more what it already was: the overseer of American National Standards--planning, approval, and maintenance--and the coordinator of U.S. participation in international nontreaty voluntary standards bodies. The explosion of technology, the time squeeze for needed standards, the escalating interest of Americans in standards, including regulators and those who trade internationally, and the increasing costs of standards activities, will call forth creative, innovative changes in the mode of standards development on both the national and international levels. It is impossible to predict how far-reaching these changes will be, and how the various standards organizations will be affected. However, this section records that those changes, as revealed in ANSI, have begun.

5.1.1 Organization and Major Roles

ANSI is a nonprofit organization that coordinates voluntary standards activities in the United States. It is governed by a Board of Directors representing all the interests cooperating within the voluntary standards system. Several councils boards and committees carry out ANSI programs with the support of a staff of 100 (ANSI, 1984). The organization of ANSI is depicted in Figure 8 and Table 3 (ANSI, 1984). More is said about this general organizational structure where it is relevant to a particular standardization activity.

Present ANSI membership consists of approximately 220 nonprofit organizational members (standards organizations, trade associations, governmental bodies [Federal and State], professional groups, etc.) and almost 1,000 large and small company members, representing virtually every facet of commerce, trade, and industry. Figure 9 (ANSI, 1983b) depicts ANSI's 1983 budget for operation of the national and international programs.

The functions of ANSI revolve around two major considerations: American National Standards and international voluntary standards bodies. Relative to the first, ANSI coordinates private sector activity (for those who wish) in the development of national standards and decides on the eligibility of standards to be called American National Standards.

ORGANIZATION OF ANSI

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                    │      Board of       │
                    │     Directors       │
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                    │ Executive/Finance   │
                    │    Committees       │
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Organizational Member Council	Company Member Council	Consumer Interest Council	Appeals Board

Certification Committee	International Standards Council	Executive Standards Council	Board of Standards Review

U.S. National Committee of IEC	Standards Boards
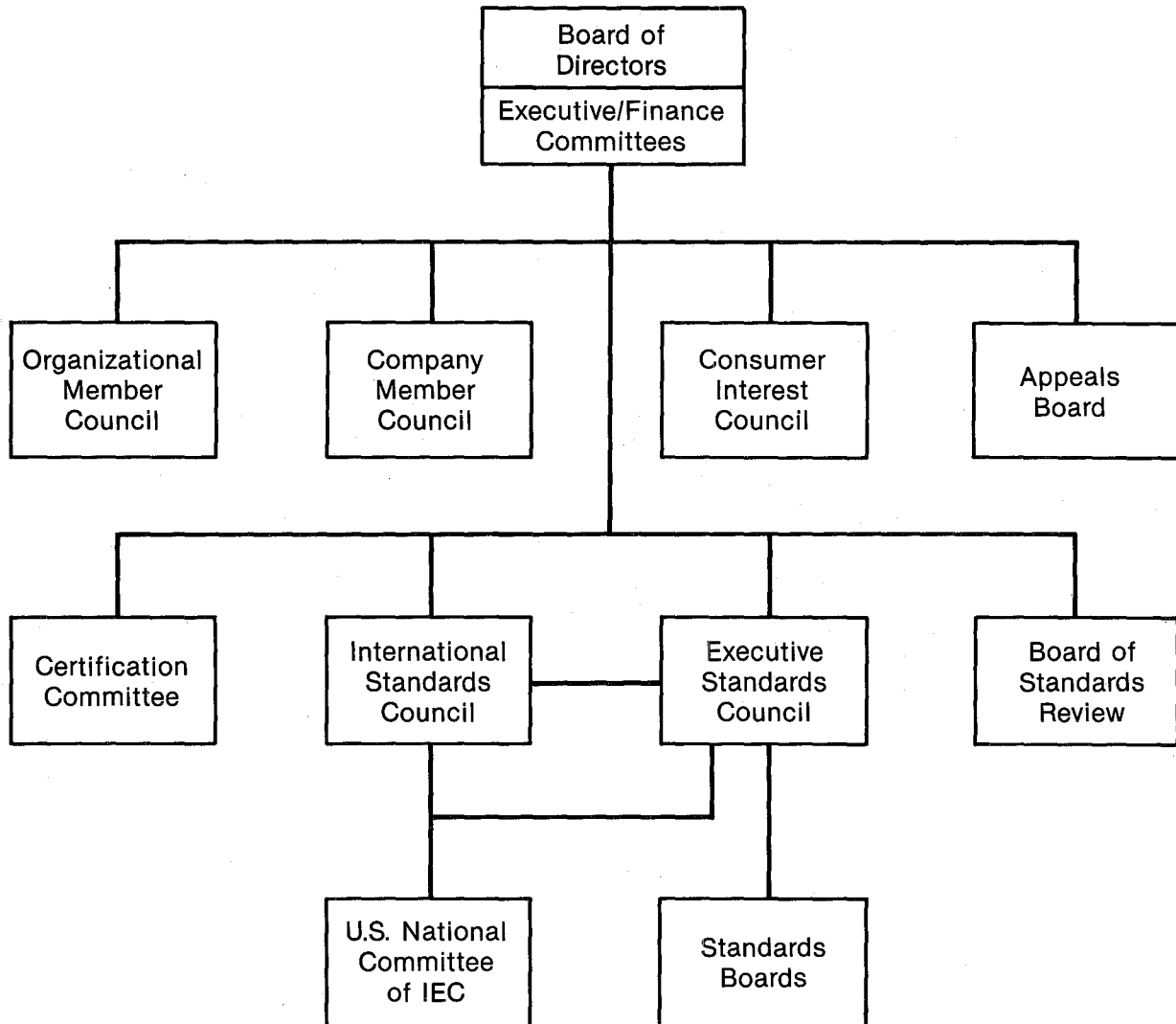
Figure 8.   The organization of the American National Standards Institute (ANSI).

Table 3. The Roles of the ANSI Organizational Units

Body	Role
Board of Directors	The governing and policymaking body of the Institute
Executive/Finance Committees	Provide guidance for administration of ANSI and act for the Board of Directors between meetings. Finance Committee maintains a continuing review of ANSI financial affairs and makes recommendations to the Board
Organizational Member Council and Company Member Council	Ensure participation of their members in ANSI programs and provide a communication channel between their members and constituents and ANSI's Board on programs and policies of the Institute; help determine standards needs
Consumer Interest Council	Responsible for consumer input to standards programs; reviews all consumer standards; represents and protects consumer interests in national standards activities
Appeals Board	Hears complaints of those who believe that they have been adversely affected by the action or inaction of any ANSI board or council
Certification Committee	Develops and operates programs leading to national accreditation of certification programs
International Standards Council	Responsible for administrative policies for ANSI's international activities
Executive Standards Council	Manages the standardization activities coordinated by ANSI—promulgates operating procedures; stimulates expeditious completion of standards work; also coordinates U.S. participation in technical work of international organizations
Board of Standards Review	Approves standards as American National Standards and acts on withdrawal and reaffirmation when it finds that a consensus exists among those substantially concerned with the scope and provisions of the standards under consideration
U.S. National Committee of IEC	Responsible for effective participation in the work of IEC and for operation of the technical advisory groups that develop the U.S. position on international electrotechnical standards
Standards Boards	Assist the Executive Standards Council in carrying out its management and coordination functions for standards development in the discipline or homogeneous technical sphere in which the particular SB operates

ANSI FINANCING FOR NATIONAL
AND INTERNATIONAL PROGRAMS—1983

Sale of Publications

Company Member Dues

Organizational Member Dues

Miscellaneous

Service Fees

Special Project Support

National Standardization Activity

International Standardization Activity

Standards Publications

Information Services

General and Administrative Services

Government Liaison

Legal and Audit Services

Consumer and Certification Accreditation Programs

Membership Services and Development

1983 SOURCES OF FUNDING

Company Member Dues	$2,000,000 (31%)
Organizational Member Dues	238,000 (4%)
Special Project Support	533,066 (8%)
Service Fees	65,000 (1%)
Sale of Publications	3,500,000 (55%)
Miscellaneous	60,000 (1%)
Total Income	**$6,396,066**

1983 APPLICATION OF FUNDS

National Standardization Activity

National Standards Coordination	$ 607,430 (9.5%)
Standards Approval	192,570 (3%)
Total	800,000 (12.5%)

International Standardization Activity

ISO/IEC Administration	819,000 (12.8%)
ISO/IEC Dues	792,000 (12.4%)
Total	1,611,000 (25.2%)

Standards Publications

Standards Editing and Printing	485,923 (7.6%)
Sales and Distribution	703,368 (11%)
Standards Purchased	1,150,966 (18%)
Total	2,340,257 (36.6%)

Information Services	197,000 (3.1%)
Membership Services and Development	197,000 (3.1%)
Consumer and Certification Accreditation Programs	132,000 (2%)
Legal and Audit Services	66,000 (1%)
Government Liaison	197,000 (3.1%)
General and Administrative Services	854,000 (13.4%)
Total Budget	**$6,394,257**

Figure 9. ANSI financing for the 1983 national and international programs.

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Relative to the second function of ANSI, ANSI manages, coordinates, and provides financial and administrative support for U.S. participation in non-government international standards bodies. ANSI is the official U.S. member of two major bodies, ISO and IEC.

Other ANSI activities include serving as a clearinghouse of information on all American National Standards and those issued by ISO and IEC, and on standards promulgated by the national standards organizations in other countries that cooperate within ISO. The representation, protection, and education of the consumer regarding standardization is another function of ANSI. ANSI also maintains Government liaison at all levels (Section 5.1.2).

ANSI produces two biweekly publications. The "ANSI Reporter" informs the reader of "policy level actions of ANSI and the international organizations to which it belongs and of standards-related actions and proposals of the U.S. government" (ANSI, 1984). "Standards Action" offers information on specific standards and calls for and provides a mechanism for obtaining comments on proposed American National Standards and certain draft international standards, documents, and proposed foreign government regulations. Listing in Standards Action is a precondition for consideration of a proposed standard as an American National Standard. In addition, all proposals for reaffirmation and withdrawal of American National Standards are announced in Standards Action. Standards Action is on-line to serve ANSI members, and the new information service is called the Voluntary Standards Information Network (VSIN), available through Information Handling Services (Englewood, CO). This data base is updated every 2 weeks as Standards Action goes to press.

5.1.2 ANSI and the U.S. Government

The Government and ANSI maintain close ties and ANSI has a Washington, D.C. office that supports this function. Almost since its founding in 1918, ANSI has "furnished advice, counsel, and testimony on standards-related issues to congressional committees" (ANSI, 1983b). There are several Government agencies that have membership in ANSI, including the National Bureau of Standards (NBS), the General Services Administration (GSA), and the Department of Defense (DOD). Members of these agencies serve on ANSI councils and boards, including the Board of Directors. ANSI also has specific connections with the Occupational Safety and Health Administration (OSHA), and the Consumer Product Safety Commission (CPSC).

ANSI cooperates with the U.S. Trade Representative's Office by, for example, responding to requests for advice on GATT Standards Code matters (see Section 6.3.3). An ANSI officer has been appointed to the Industry Functional Advisory Committee (IFAC) on Standards for Trade Policy Matters. IFAC is advisory to a program on trade that provides the Secretary of Commerce and the U.S. Trade Representative with advice on trade negotiations and the administration of U.S. trade policy that reflects the concerns and interests of the private sector. IFAC members are representatives from private industry engaged in standards-related activities.

5.2 ANSI Plans and Coordinates Preparation of American National Standards

The ANSI activity that embraces most clearly the original intent of its foundation is the coordination and harmonization of private sector national standards activities. Today, as in 1918, adherence to ANSI's guidelines is voluntary. This cooperation means that the interested standards-developing groups and affected interests, both private and Government, voluntarily use the criteria, requirements, and guidelines developed by ANSI as a method of ensuring that the standards meet national needs, do not duplicate each other's efforts or produce conflicting standards, and are produced efficiently without undue effort.

ANSI assists participants in identifying particular U.S. standards needs, and then aids in planning ways to provide American National Standards to meet those needs. This includes encouraging joint and cooperative ventures and liaison activities. The revised procedures of ANSI (ANSI, 1983b) request that standards developers register their projects with ANSI. Such information will provide a central data bank of voluntary national standards information, available during development and after approval and publication. The data bank, useful for spotting potential duplication of standardization activities, is now a key element in the planning and coordination activities of ANSI. This will provide direct information to all interested parties.

Several ANSI activities relative to the coordinating role discussed above concern the involvement of the United States in international standards activities. The promulgation of conflicting American National Standards would hinder the development of a unified U.S. position internationally. More is said on this aspect of ANSI's work in Section 7.

The overall responsibility for ANSI's national (and international) planning and coordinating functions is held by the Executive Standards Council (ExSC). The ExSC is assisted in its supervisory tasks by the 16 Standards Boards (formerly called Standards Management Boards), each of which coordinates activities in a designated discipline or homogeneous technical sphere.

5.3 ANSI Approves Standards as American National Standards

The second role of ANSI has permitted the highly decentralized U.S. voluntary standard system to develop a consistent set of 8,500 American National Standards. Any organization that wishes to upgrade a particular consensus standard to a fully accredited American National Standard must go through the process established and supervised by ANSI. This is the only recognized way in the United States for the establishment of an American National Standard.

5.3.1 Approval Criteria

In the performance of this task, ANSI fulfills two main functions: verification that the established criteria for an ANS have been met in the original formation process of the standard, and supervision of the designation, publication, and maintenance of the approved ANS.

In the first case, ANSI verifies that the requirements for due process and consensus (listed in Section 4.1.2) and certain other criteria for approval have been met. Approval thus assures the user that each American National Standard is generally acceptable to directly and materially affected interests that participated in the development of consensus for the standard. The ANSI Board of Standards Review (BSR) reviews all pertinent evidence and decides whether a proposed standard is to be an ANS. Similarly, it approves proposals to reaffirm or withdraw standards.

In addition to acceptance by the BSR that the criteria for consensus have been met, further evidence is obtained through ANSI's public review process. Every proposed new or revised standard is announced in Standards Action and during a specified period anyone may obtain a copy of the proposal and then submit comments. These comments must be considered and acted upon by the standards developers. Comments and responses become part of the evidence of consensus reviewed and acted upon by the BSR.

Before final approval, the BSR will ascertain evidence that:

1. Due process requirements were met.

2. Consensus was achieved.

3. The standard is within the field previously registered with ANSI.

4. Any identified significant conflict with another ANS was resolved.

5. Other known national standards were examined with regard to harmonization and duplication of effort.

6. The proposed ANS was examined relative to existing international standards.

7. Any appeal to the standards developer was completed.

8. Patent issues were resolved.

9. No evidence stands that claims the proposed ANS is contrary to public interest, contains unfair provisions, is unsuitable for national use, or is technically inadequate.

10. The ANS does not duplicate existing or proposed ANS (unless there is a compelling need) (ANSI, 1983c).

The withdrawal of an established ANS for any of several reasons that are the reverse of the above-listed ten points is also the responsibility of the BSR.

5.3.2 Accreditation of American National Standards Developers

A major element in the approval of a candidate standard as an ANS is evidence of consensus. ANSI recognizes three methods for developing such evidence, each of which is considered to be equivalent in the final results. A standards developer may be accredited by ANSI to use one or more of these three methods:

1. Accredited Organization Method,
2. Accredited Standards Committee Method, and/or
3. Accredited Sponsor Using the Canvass Method.

The reader familiar with ANSI before 1983 will be more acquainted with the following terms for 2 and 3 above: American National Standards Committee Method (ANSC) and Canvass Method.

At present, the only ANSI-accredited standards-developing organization involved in telecommunication standards is IEEE. The IEEE segment dealing with telecommunications represents an amalgamation of many professional societies addressing a cross section of electrotechnology. Section 5.4.3 discusses recent ANSI/IEEE coordination in telecommunication standards.

The Canvass Method involves having the sponsoring organization subject a proposed standard (not developed by either an accredited organization or

accredited standards committee) to an extensive canvass of materially affected interests, following prescribed ANSI procedures. This method has been used, for example, in the approval of the military standard Ada, a computer programming language selected by DOD to replace the hundreds of languages currently in use. DOD acted as the sponsor, and the approval of the new American National Standard (ANSI/MIL-STD 1815 A-1983) resulted from a cooperative effort of the Department of Defense, industrial organizations, universities, and foreign military departments.

The Accredited Standards Committee Method is discussed in Section 5.4. Before presenting this method of developing evidence for consensus, the recent changes and the reasons for these changes in ANSI procedures are presented below.

5.3.3 Recent Changes in ANSI Procedures

In implementing the National Policy on Standards (Section 4.3.2) ANSI reviewed its organizational structure vis-à-vis the NPS requirements for a Private Sector Standards Coordinating Center. In consequence, certain ANSI functions were redirected or their emphasis was changed. The actions taken are listed in ANSI's plan to implement NPS (ANSI Reporter, 1981). The first of these actions, proposed in 1981, and the one of interest here, involved ANSI's purpose to amend its bylaws so that they would definitively prohibit ANSI from standards development and would "modify the structure and designation of American National Standards Committees to eliminate any possibility of a perception that ANSI develops standards" (ANSI Reporter, 1981).

During the past several years, ANSI has expressed concern about the tendency of the American public to equate ANSI with the actual development of standards. In particular, ANSI does not compete with any of the hundreds of industry, labor, and Government groups involved in standards development. ANSI is the vehicle through which they can coordinate and integrate their efforts at the national level.

It is very common, almost universal, to hear the American National Standards referred to as "ANSI Standards" when, in fact, they are "ANSI-Approved Standards." The ANS designation code (e.g., ANSI/UL 864-1980) that requires this format (i.e., ANSI/sponsoring organization) by which American National Standards are listed has contributed to the use of the term "ANSI

Standard" and to the "obvious" conclusion that "this is a standard developed by ANSI."

Another almost universal misunderstanding was revealed in the reference of an American National Standards Committee (ANSC) as an "ANSI Committee." The American National Standards Committees, as discussed here and in Section 5.4, was the name applied to standards committees operating under ANSI-approved procedures (prior to September, 1984), and designed to develop national standards. The standards thus developed go through the ANSI process before approval as American National Standards. Therefore, since terminology seems to precede concept in both of these cases, "ANSI Committees" developed standards, therefore "ANSI develops standards."

American National Standards Committees that existed before September 1, 1983 were required to become Accredited Standards Committees (ASCs) or to become accredited under the Accredited Organization Method or the Accredited Sponsor Using the Canvass Method by September 1, 1984. For those American National Standards Committees that changed to Accredited Standards Committees, the changes evident from the new procedures imply less ANSI oversight responsibility for the organizational details. For future Accredited Standards Committees, instead of establishing the committee as it has in the past, ANSI will now accredit committees established by other groups. A recent example of this is the ESCA committee T1, which was approved by ANSI as an accredited standards committee in September 1984 (see Section 5.4.3).

5.4 Accredited Standards Committees

Of the three types of ANSI accreditation listed in Section 5.3.2, the Accredited Standards Committee (ASC) Method is most relevant to this report. As of October 1981, there were 200 American National Standards Committees (ANSI, 1981a) assigned to the 16 ANSI Standards (Management) Boards. The six Committees then assigned to the Information Systems Standards Board, for example, were:

    D20: The States' Model Motorist Data Base;
    X3: Information Processing Systems;
    X9: Financial Services;
    X12: Business Data Interchange;
    Z39: Library Work, Documentation,Related Publishing Practices; and
    Z85: Standardization of Library Supplies and Equipment.

By 1984, there were 235 American National Standards Committees (ANSI Reporter, 1984a).

The committees, the work of which is financed by the organizations whose representatives participate, are not owned by ANSI. The organizations must agree to two major items: to cooperate under ANSI procedures on the desired standards, and to submit the finished product of their work to ANSI when approval of it as an American National Standard is desired.

The ANSI-proposed model procedures for the organization and proper functioning of an ASC are summarized below. This general discussion is followed by a presentation of 1) the highly productive, 20-year-old ASC X3, "Information Processing Systems," and 2) the newly formed ASC T1, "Telecommunications."

5.4.1 Model Procedures for an ASC

The basic ASC structure consists of a secretariat and the committee membership. The secretariat is an organization that assumes responsibility, financial and managerial, for the functioning of the committee under ANSI's accreditation requirements. The secretariat that organizes a committee must then oversee compliance with ANSI's procedures. In addition, the secretariat is obliged to provide a secretary (and support staff) to perform the necessary administrative duties including: meeting notices and arrangements; preparation and distribution of meeting agendas, reports, ballots, and draft standards; and maintenance of records.

Members of a committee consist of organizations, companies, Government agencies, individuals, etc., having a direct and material interest in the activities of the committee. The "committee membership" refers to the parent committee and this term does not include members of subcommittees, working groups, etc. The parent committee is responsible for the development of standards and all related activities including the response to requests for interpretation of standards. ANSI's new procedures (ANSI, 1983a) state:

> Official interpretations of American National Standards shall be made only by the accredited standards developer responsible for maintenance of that standard. ANSI shall not issue, nor shall any person have the authority to issue, an interpretation of an American National Standard in the name of the American National Standards Institute. Requests for interpretations addressed to ANSI shall be referred to the responsible standards developer.

The request for membership in the committee is made to the secretariat. Neither committee members, nor subcommittee members (see below) are required to be ANSI members or representatives of ANSI members. The secretariat is

required to ascertain that "the membership shall be sufficiently diverse to ensure reasonable balance without dominance by a single interest category." Membership is open to anyone having a "direct and material interest in the committee's work and qualifications and willingness to participate actively."

Interested individuals and organizations may request listing as observers. The committee may also select individual experts for assistance. Observers and individual experts are advised of the committee activities, may attend meetings, and may submit comments for consideration. They have no vote.

A committee may, with appropriate public notice, form subgroups of non-committee persons to expedite its work as needed. This varies from committee to committee. The chairman and members of the subgroup are appointed by the committee chairman. Subgroup meetings are held as needed upon the decision of the subgroup chairman and members.

The meetings of the committee and subgroups are open to all members and to others having direct and material interest. This open policy, intrinsic to the nature of standards development in the United States, has nevertheless certain unresolved problems associated with it. For example, as attendance at meetings by representatives of multinational companies and/or jointly owned companies (U.S./other) grows, so does the risk of having non-U.S. objections advanced at the meetings. This input might contribute to a better technical standard or might slow the process.

Another related problem concerns the preparation of a U.S. position on a standard for the international arena. The need to present a unified U.S. position internationally is critically important; the need to develop agreed-upon fall-back positions is equally important for effective and compelling negotiation. The degree of confidentiality needed to develop these "unpublicized" fall-back positions is potentially compromised by the presence of non-U.S. members. Because standards meetings are "open" this problem is a challenge to the present standards community.

5.4.2 ASC X3: Information Processing Systems

The ANSI procedures define the committee organization only to the parent committee level. Each ASC can structure its subgroups as it sees fit, within the general ANSI guidelines. The following discussion of X3 illustrates an extension of these concepts and principles to lower level organization.

The present ASC X3 evolved from a 1980 merger of the original ANSC X3, "Information Systems" (1961), and ANSC X4, "Office Machines" (1961). The secretariat for X3 is (and was) the Computer and Business Equipment Manufacturers Association (CBEMA). A CBEMA office is maintained in Washington, D.C. to house the CBEMA/X3 effort.

The scope of X3 covers standardization in the areas of computers, information processing, peripheral equipment, and the related devices and media; standardization of the functional characteristics of office machines, plus accessories for such machines, particularly in those areas that influence the operators of such machines. The title of X3 was changed from "Information Systems" to "Information Processing Systems" in 1982.

Figure 10 (CBEMA, 1983a) is an organizational chart representing X3 and its relationship with ANSI (part A of the chart), and with its two standing committees and 37 technical committees (part B of the chart). The parent committee, X3, in 1983 was comprised of 21 producer members, 15 consumer members and 9 general interest members. An additional 9 observer members included an ANSI TC97-liaison member. The parent committee is the decision-making body responsible for developing the evidence of consensus necessary for ANSI's approval of American National Standards. The entire structure indicated in Figure 10 (minus the two ANSI blocks) is the "X3 Organization".

As indicated in Figure 10, the secretariat staff is aided by a Secretariat Management Committee (SMC). This group assists the X3 Secretary in the appointment of officers, budget, expenditure, arrangement of international meetings, etc. The X3 contacts with ANSI are made through the secretariat staff or directly with the Information Systems Standards Board (ISSB).

Section B of Figure 10 includes the Standards Planning and Requirements Committee (SPARC), which is advisory to X3 on new standards requirements and on review of proposed standards. Its considerations are functional and economic, rather than technical.

The other X3 standing committee is the International Advisory Committee (IAC). The IAC advises X3 on matters of policy and overall participation of X3 in international activities. The international activity of X3, an accelerating portion of X3 work, is discussed in Section 7.5.5.

The remainder of Section B in Figure 10 is composed of the X3 subgroups-- technical committees (TC) and various task groups (TG). The subgroups assist X3 and their work is advisory to X3 or done on behalf of X3. The thousands of

ANSI
American National Standards Institute

ISSB

SMC
Secretariat Management Committee

Secretariat Office

CBEMA
Computer & Business Equipment Manufacturers Association

A

American National Standards Committee X3
Information Processing Systems

Consumer Members	General Interest Members	Producer Members

X3 Standing Committees

SPARC
Standards Planning & Requirements Committee

Programming Language Planning Group

IAC
International Advisory Committee

Optical Digital Data Disk Study Group

SPARC/Data Base Management Systems

TAG to SC5 **

TAG to SC19 **

X3 Technical Committees

B

A—Recognition

X3A1	OCR
X3A1.1	Font Design
X3A1.2	OCR Supplies and Forms
X3A1.3	Image Def. Measurement
X3A7*	MICR

B—Media

X3B1	Magnetic Tape
X3B2*	Perforated Media
X3B3*	Punched Cards
X3B5	Mag. Tape Cassettes
X3B6	Instrumentation Tape
X3B7	Magnetic Disks
X3B8	Flexible Disks
X3B9	Paper Forms/Layouts
X3B10	Credit/ID Cards
X3B10.1	Integrated Circuit Cards

H & J—Languages

X3H1	OP Sys Cmd & Resp Language
X3H2	Database
X3H3	Computer Graphics
X3H3.1	Core Graphics System
X3H3.2	Reference Models
X3H3.3	Virtual Device Interface
X3H3.4	Conformance & Binding
X3H3.5	Min. Interface to Graphics
X3H4	Information Resource & Dictionary System
X3J1	PL/I
X3J1.2	PL/I Gen. Purpose Subset
X3J1.4	PL/I Real Time Subset
X3J2	BASIC
X3J3	FORTRAN
X3J4	COBOL
X3J4.2	COBOL Data Base
X3.4.3.	COBOL DML
X3J5	COMPACT/ACTION/SPLIT
X3J6	Text Processing
X3J6.1	Text Description
X3J7	APT
X3J9	PASCAL
X3J10	APL
X3J11	C

K—Documentation

X3K1*	Project Documentation
X3K2*	Flowchart Symbols
X3K5	Vocabulary
X3K7	Program Abstracts

L—Data Representation

X3L2	Codes & Character Sets
X3L2.1	Videotex/Teletext
X3L5	Labels & File Structure
X3L8	Data Representation
X3L8.3	Indiv. & Bus. ID
X3L8.4	Geographical Units

S—Communication

X3S3	Data Communication
X3S3.1	Comm. Stds. Planning
X3S3.2	Comm. Vocabulary
X3S3.3	Network Layer
X3S3.4	Control Procedures
X3S3.5	Comm. System Performance
X3S3.6	Transmission Speeds
X3S3.7	Public Data Networks

T & V—Systems Technology

X3T1	Data Encryption
X3T1.1	Data Link Encryption
X3T5	Open Systems Interconnection
X3T5.1	Architecture
X3T5.4	OSI Management Protocols
X3T5.5	Application & Pres. Layers
X3T5.6	Session & Trans. Layer
X3T9	I/O Interface
X3T9.2	Lower Level Interface
X3T9.3	Device Level Interfaces
X3T9.4	I/O Operational Specifications
X3T9.5	Loc. Dis. Data Interface
X3T9.6	Cartridge Tape Drives
X3V1	Office Systems
X3V1.1	User Requirements
X3V1.2	Symbols & Terminology
X3V1.3	Text Structure
X3V1.4	Procedure for Text Interchange
X3V1.5	Text Preparation & Presentation

**Technical Advisory Groups to ISO TC97 Subcommittees (see Section 7).

*Inactive Status

Figure 10. The 1983 relationship of ANSC X3 with ANSI (part A) and with its technical committees (part B).

volunteers who participate in the technical committees and task groups are drawn from industry, Government, user groups, etc. Each subgroup is responsible for the definitive content of one or more standards.

The 1983 activity of the X3 Organization consisted of 250 projects, with 130 standards at some point of reference (CBEMA, 1983b). The secretariat is responsible for 2500 registered documents yearly, exclusive of internal (X3) TC documents.

X3 administers its responsibilities for consideration and development of standards within its scope by means of a Project Management System. This system provides a means of identifying, cataloging, monitoring, and reporting its activities, and of filing its technical papers. Although a project may be terminated by an X3 decision at any time prior to the standard's completion, once an American National Standard is published the project remains, going through cyclic maintenance, revision, and/or reaffirmation stages as required until the standard is withdrawn.

The Project Management System is depicted in Figure 11. The percents given represent the amount of 1983 project work that was included within that particular category (CBEMA, 1983b).

The five stages in the Project Management System are:

1. Study: new X3 work is initiated by a proposal, which, if sufficient interest is found, causes initiation of a Study Project to determine the feasibility and need for standards on that subject.

2. Development: upon 2/3 of the X3 membership's approval, work is begun to develop a candidate ANS. Typically, about 34% of the X3 Organization activity is in this stage.

3. Maintenance: when the proposed standard is approved by ANSI as an ANS, the project is automatically placed in this status. As appropriate in individual cases, maintenance activity also includes the support by X3 toward adoption of its technical content as an International Standard.

4. Revision: conversion to this stage depends upon results of experience with and comments on the standard. It occurs when a substantive change in the standard is proposed to and approved by X3.

5. Reaffirmation: 5 years after its publication, the standard is reviewed. If no modifications are required, the project is converted to this status.

A second kind of project, accounting for 20% of the work in 1983, is called a "Liaison" project. Liaison projects give formal recognition to the work of an industry, the Government, or a professional or international standards body in which X3 has an interest but for which it has no existing

PROJECT MANAGEMENT SYSTEM of X3

DIRECT X3 ORGANIZATION ACTIVITY*

```
+-------------------------------+      +-------------------+      +-------------------+
| Proposal→STUDY→Recommendation |  →   |   DEVELOPMENT     |  →   |   MAINTENANCE     |  →
|         (X3/SPARC)            |      |                   |      |                   |
+-------------------------------+      +-------------------+      +-------------------+
         Stage 1 (4%)                     Stage 2 (34%)             Stage 3 (25%)
```

```
              +-------------------+      +-------------------+
              |     REVISION      |  →   |   REAFFIRMATION   |
              +-------------------+      +-------------------+
                 Stage 4 (15%)             Stage 5 (2%)
```
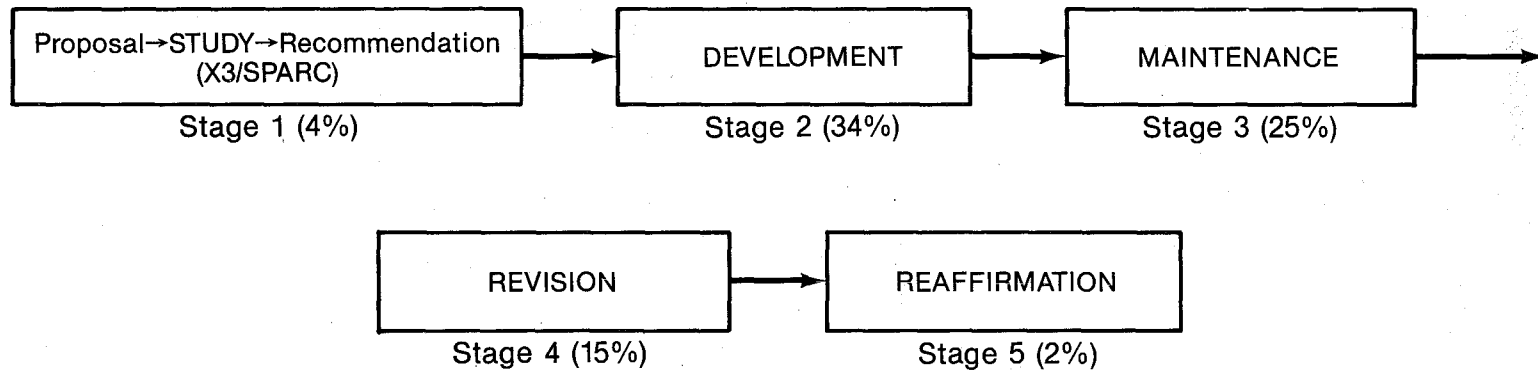
* 1983 statistics: percent of total X3 projects in this stage of development.
  These figures add up to 80%. The other 20% of activity is centered in "Liasison Projects"(see text).

Figure 11. Flow chart representation of the project management system
            of ANSC X3.

standard or work in process. A liaison project is automatically established for each project established by the comparable international committee ISO/TC97, and for others when requested by an X3 Technical Committee and approved by SPARC and X3. These projects as initially established are "passive"--for information receipt only. Upon request by the X3 Technical Committee and approval by SPARC and X3, they may become "active" liaison to permit technical contribution and participation. Upon approval by SPARC and X3, they may also become development projects, to develop corresponding American National Standards.

A third kind of project is defined by X3 as the "International Development" project. This activity relates to an approved New Work Item (NWI) of ISO which X3 has committed to support, and which is intended to result in an International Standard. The standardization process is actually focused in stage 2 of Figure 11, "Development."

As a by-product of the standards development process and the resource of knowledge devoted to it, X3 has initiated a series of "Technical Reports." "Such Technical Reports are not standards, nor are they intended to be used as such" (CBEMA, 1982).

X3 Technical Reports are intended, in some cases, to disseminate the technical and logical concepts reflected in standards already published or under development. In other cases, they derive from studies in areas where it is found premature to develop a standard due to a still changing technology, or inappropriate to develop a rigorous standard due to the existence of a number of viable options, the choice of which depends on the user's particular requirements. Therefore, these Technical Reports produce guidelines, the use of which can result in greater consistency and coherence in information processing systems.

One report in the series is a vocabulary document (X3K5), labelled X3/TR-1-82, and titled, the "American National Dictionary for Information Processing Systems" (CBEMA, 1982). This document was at one time the American National Standard X3.12. When it became apparent that the dynamic change in the information processing technology needed a more rapid turnaround for dissemination of consensus-developed definitions, X3 voted to remove the Dictionary from the status of an American National Standard and put it in the X3 Technical Report Series.

5.4.3 ASC T1: Telecommunications

The second ANSI Accredited Standards Committee discussed in this report is one just emering from the formation stage and envisioned as a telephony equivalent of X3. The following discussion of the evolution of T1, besides being of intrinsic interest to the reader because it deals with telecommunications, serves also to exemplify the constantly changing nature of the standardization process, dynamically adapting to new needs and new technologies, as discussed in Section 1.2. Committee T1 represents a creative effort on the part of telephone carriers to join the voluntary standards community. The formation of T1 clearly indicates that the post-AT&T-divestiture exchange carrier industry believes that such a public forum is the best mode available for obtaining a basic U.S. telecommunication standards position (which has formerly been the Bell System practice, represented by AT&T) among all the carriers and other interested parties.

The following discussion involves 1) a description of the newly formed Exchange Carriers Standards Association (ECSA) that serves as the T1 secretariat; 2) the reasons why the new telephone standards committee is considered necessary by its proponents; 3) some particulars about T1 and the standards community; and 4) recent internal ANSI actions regarding telecommunication matters.

The Exchange Carriers Standards Association (ECSA)

On August 1, 1983, ECSA came formally into existence with the first Board of Directors' meeting. The ECSA, a private, voluntary association of the exchange carriers industry, was formed to address technical standards and related issues in the post-AT&T-divestiture environment. As such, ECSA is designed to accomplish two major purposes: to provide a forum for, and to represent exchange carrier interests in, standards and related technical fields affecting the industry; and to act as secretariat for the independent interconnection standards committee, "Telecommunications."

Membership in the ECSA organization is open to all wireline exchange carriers with representation on the diverse 21-member Board of Directors. The Board consists of eight representatives of carriers with over 7,000,000 access lines (7 post-divestiture Regional Bell Operating Companies and GTE-Telephone); 8 representatives of carriers with between 3,000,000 and 7,000,000 access lines (United Telephone, Continental Telephone, Southern New England Telephone, Central Telephone, Midcontinent Telephone, Cincinnati Bell, Puerto

Rico Telephone, and Rochester Telephone); and 5 representatives of carriers with less than 3,000,000 access lines (selected from the combined group). As of April 1984, ECSA's membership included more than 110 exchange carriers and holding companies (Lifchus, 1984).

The role of the ECSA Board is oversight of the work of the ECSA committees. These committees include:

1. the Exchange Telephone Group Committee: to maintain oversight of ECSA's membership in ANSI and other relevant standards bodies;

2. the Standards Advisory Committee: to be responsible for ECSA activities in the Accredited Standards Committee T1; and

3. the Liaison Committee: to oversee external ECSA relations, including those with other standards organizations.

At its August 1 meeting, ECSA's Boards of Directors took a stand on proposed Federal Communication Commission rulemaking that involved interface standards for interconnection and operability among various providers of telecommunications services and equipment. The FCC proposed that the functions of the Exchange Carriers Association (ECA), (recently renamed National Exchange Carriers Association--NECA), formed to handle tariffs and revenue distribution, be expanded to include development of interconnection standards.

The position taken by ECSA was that "no direct FCC regulatory involvement is needed" (Telecommunications Reports, 1983c). In response to the FCC filing, Common Carrier Docket No. 78-72, ECSA stated:

A separate association, apart from the Exchange Carriers Association (ECA) and its joint access exchange tariff and revenue distribution functions, is needed for the formulation of technical interconnection standards;

An ECSA-sponsored ASC T1 committee is the most appropriate forum and organization for the needed development of voluntary interconnection standards by private industry; and

Given the organization, structure, and procedures of the ECSA and the sponsored T1 committee, no direct FCC regulatory involvement in the interconnection standards formulation process is necessary or desirable.

ECSA's recommendations to the FCC were supported by ANSI in ANSI's own comments on the FCC proposed rule. ANSI recommended that "interconnection standards be prepared by the voluntary sector through the Exchange Carriers Standards Association and not by the FCC" and that "FCC follow the provisions of the OMB Circular A-119, which calls for Government agencies to use

voluntary standards and participate in the voluntary standards process" (ANSI Reporter, 1983b).

The Scope and Organization of ASC T1

The scope of T1 addresses the formulation of industry interconnection standards. The scope and responsibilities of T1 are:

> Committee T1 develops standards and technical reports related to interfaces for U.S. networks which form part of the North American telecommunications system. T1 also develops positions on related subjects under consideration in various international standards bodies. Specifically, T1 focuses on those functions and characteristics associated with the interconnection and interoperability of telecommunications networks at interfaces with end user systems, carriers, and information and enhanced service providers. These include switching, signaling, transmission, performance, operation, administration, and maintenance aspects. Committee T1 is also concerned with procedural matters at points of interconnection, such as maintenance and provisioning methods and documentation, for which standardization would benefit the telecommunications industry (Lifchus, 1984).

At the first T1 meeting (February 2, 1984), the bylaws were approved, and the preliminary general structure of the T1 organization was established: an Advisory Committee, and six Technical Subcommittees (TSCs). Figure 12 indicates that general T1 structure: Table 4 lists the working group titles.

The officers of T1 serves as a 10-member Advisory Group, designated T1AG consisting of the T1 Chairman and Vice-chairman, and two representatives from each of the four membership categories. These categories, and the number of T1 members in each, are: exchange carriers (18), interexchange carriers (17), manufacturers (30), and users and general interest (9). An additional three liaison members include the X3 Technical Committee, X3S3 (Data Communications); ANSC X12 (Business Data Interchange), and the Canadian Standards Association.

The six TSCs and their general responsibilities are:

1. Carrier to Customer Premises Equipment Interfaces (T1C1): Telephone user-to-network and non-ISDN interfaces; private network-to-PSTN and PDN gateways; PABX-to-public network interfaces; analog voiceband interfaces; extended framing format for 1.554 Mb/s. CPE is an acronym for customer premises equipment.

2. ISDN (T1D1): All aspects of ISDN services, including network-to-network and user-to-network interfaces, gateways and protocols; protocol architecture; ISDN lower layers; numbering plans and administration.

Organization Structure
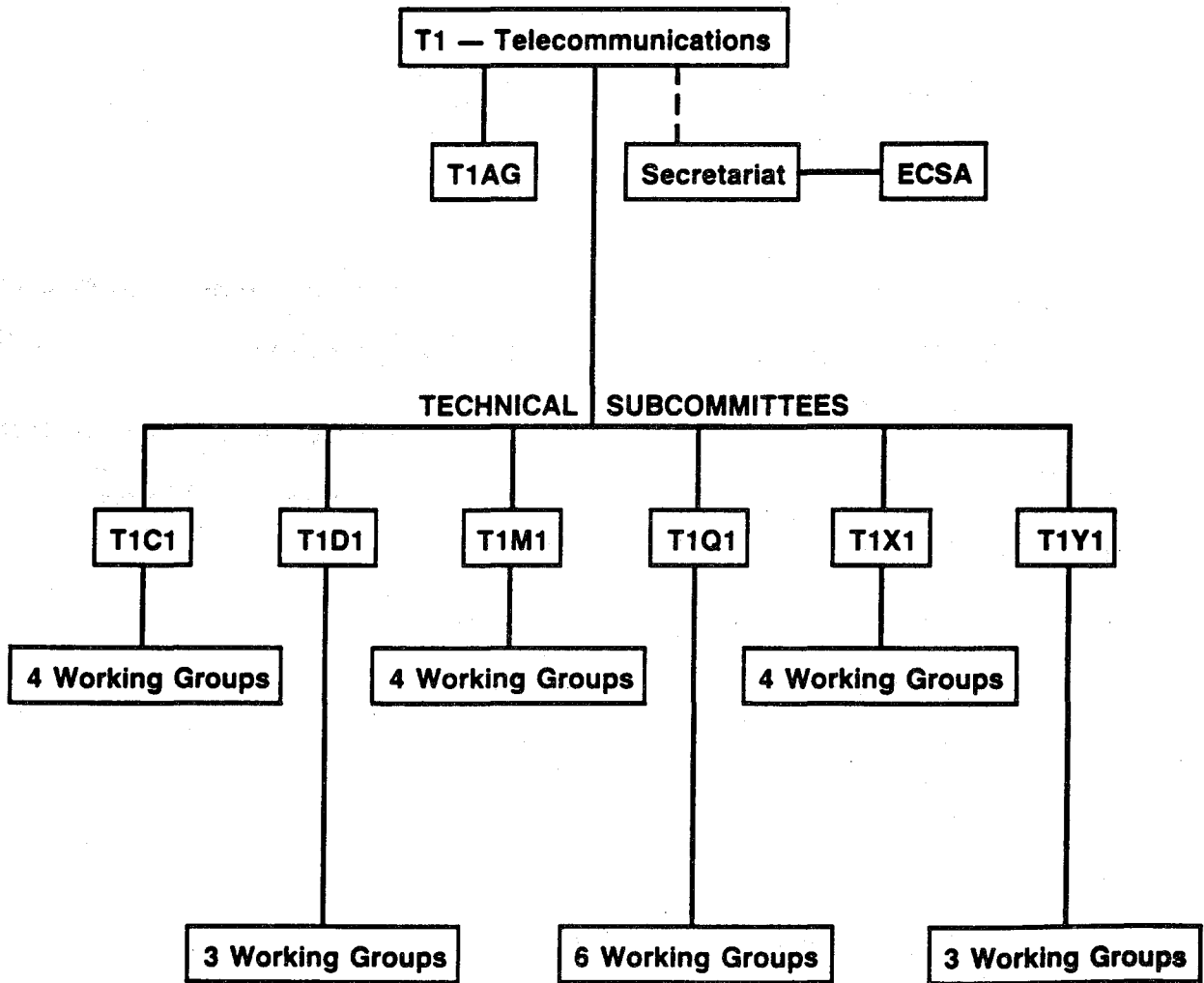
Figure 12. The general structure of ASC T1.

Table 4. The Titles of the ASC T1 Technical Subcommittees and Working
Groups Depicted in Figure 12

T1AG — T1 Advisory Group

T1C1 — Carrier to Customer Premises Equipment Interfaces

    T1C1.1 — Analog Interfaces
    T1C1.2 — Digital Interfaces
    T1C1.3 — Special Interfaces
    T1C1.4 — Editing

T1D1 — Integrated Services Digital Networks (ISDN)

    T1D1.1 — ISDN Architecture and Services
    T1D1.2 — ISDN Switching and Signaling Protocols
    T1D1.3 — ISDN Physical Layer

T1M1 — Internetwork Operations, Administration, Maintenance and Provisioning

    T1M1.1 — Internetwork Planning and Engineering
    T1M1.2 — Internetwork Operations
    T1M1.3 — Testing and Operations Support Systems and Equipment
    T1M1.4 — Administrative Systems

T1Q1 — Performance

    T1Q1.1 — 4kHz Voice
    T1Q1.2 — Voiceband Data
    T1Q1.3 — Digital Circuit
    T1Q1.4 — Digital Packet
    T1Q1.5 — Wideband Program
    T1Q1.6 — Wideband Analog

T1X1 — Carrier to Carrier Interfaces

    T1X1.1 — Common Channel Signaling
    T1X1.2 — Carrier Interface
    T1X1.3 — Digital Network Synchronization
    T1X1.4 — Hierarchical Rates and Formats

T1Y1 — Specialized Subjects

    T1Y1.1 — Specialized Video and Audio Services
    T1Y1.2 — Specialized Voice and Data Processing
    T1Y1.3 — Advanced Technologies and Services

3. <u>Internetwork Operations, Administration, Maintenance (OAM) and Provisioning (T1M1)</u>: Network management standards; OA&M systems interface languages and telemetry; location, circuit and equipment common identification; test equipment specifications; ordering, provisioning and restoral procedures; universal billing data interchange formats; automatic transmission measuring systems interfaces; telephony network tones and announcements.

4. <u>Performance (T1Q1)</u>: Allocation of minimum digital, data network, and voice transmission performance standards; performance standards for analog audio program sound transmission; minimum performance standards for local exchange and interexchange reference connections.

5. <u>Carrier to Carrier Interfaces (T1X1)</u>: This subcommittee's field consists of exchange access interfaces, digital network synchronization, restructured DS3 format, common channel signaling systems, and mid-span connections.

6. <u>Specialized Subjects (T1Y1)</u>: Exchange carrier-cellular carrier interfaces, including land-based mobile cellular systems; enhanced video services; program sound; teleconferencing; voice coding, including encoding algorithms and speech processing.

As T1 evolves, it will continue to solicit standards projects and participation from all interested parties, eventually providing unified positions under due process. The newly formed ANSI Joint Telecommunication Standards Coordinating Committee (JTSCC) will review any final projects (see below). Membership in T1 is open to all parties "with a direct and material interest in interconnection standards--exchange carriers, interexchange carrier, enhanced service providers, equipment manufacturers, and vendors, user groups, professional associations, and Federal and state Government agencies--without dominance by any single interest" (Graf, 1983). In keeping with ANSI-required procedures, parties with specific interests are welcome to join any combination of TSCs, without requiring T1 membership. Observer status membership is also available. All meetings are open to the public.

T1 and the Standards Community

The development of T1 by the exchange carriers industry is a response to at least two major issues of the 80's. The first, discussed in Section 4.2.2 in relation to the FCC, stems from the void left in telecommunication standards leadership by the AT&T divestiture:

> Many of the standards created and maintained by the unified Bell System may be adapted by existing standards developers. Others may find a home under new organizations, such as the Exchange Carriers' Standards Association (ECSA) . . . Still other standards may

simply cease to exist as a result of the breakup. Only time will tell (Cohen, 1983).

The second issue concerns the rapidly escalating standards activities associated with the Integrated Services Digital Network (ISDN) and the Open Systems Interconnection (OSI) Reference Model. The second issue of concern exists largely independent of the divestiture.

Both of these systematically planned standards activities--ISDN and OSI-- involve public telephone networks and public data networks. Liaison in standards development between the telephony and data industries is required to an extent never realized in the past when standards committees were clearly dedicated to either telecommunication or computer standards. Sections 8 and 9 discuss the U.S. cooperative standards efforts in the ISDN and OSI efforts, respectively. This present discussion refers to the structural changes that are occurring in the national standards community.

The telecommunication industry in general has not had a specific role in American National Standards activities because the Bell Standards were the de facto "national standards." In addition, characteristics of the telecommunication network did not really affect the individual user, so telephony never really needed a national standards forum before.

In contrast, the needs of the computer industry have been served nationally by X3 for two decades, and the direct path to the international arena in ISO was obvious. The modems and physical interfaces needed to bridge or interconnect computers to the public telephone network were developed by Bell, the Electronics Industries Association (EIA), CCITT, etc. Part A of Figure 13 illustrates this historical reality.

The telecommunication industry is now at a unique crossroads. Part B of Figure 13 illustrates the problem. Bridges are not sufficient in today's networks. Although there are issues specific to the telecommunication or computer worlds, there is an extensive area of overlapping technologies, including ISDN and OSI issues, more and more occupying the same lanes. Figure 13 illustrates only the U.S scene, but the same is true for international standards organizations (dealt with in Sections 8 and 9).

Although the ISDN involves both telecommunication and data processing services, it is still widely held that the 90% of telecommunications that is voice today will have only dropped to 80% by 1990. During the past 4 years, the telecommunication industry has had the U.S. CCITT Study Group D, and (since 1981) the ISDN Joint Working Party (JWP) and its Technical Working
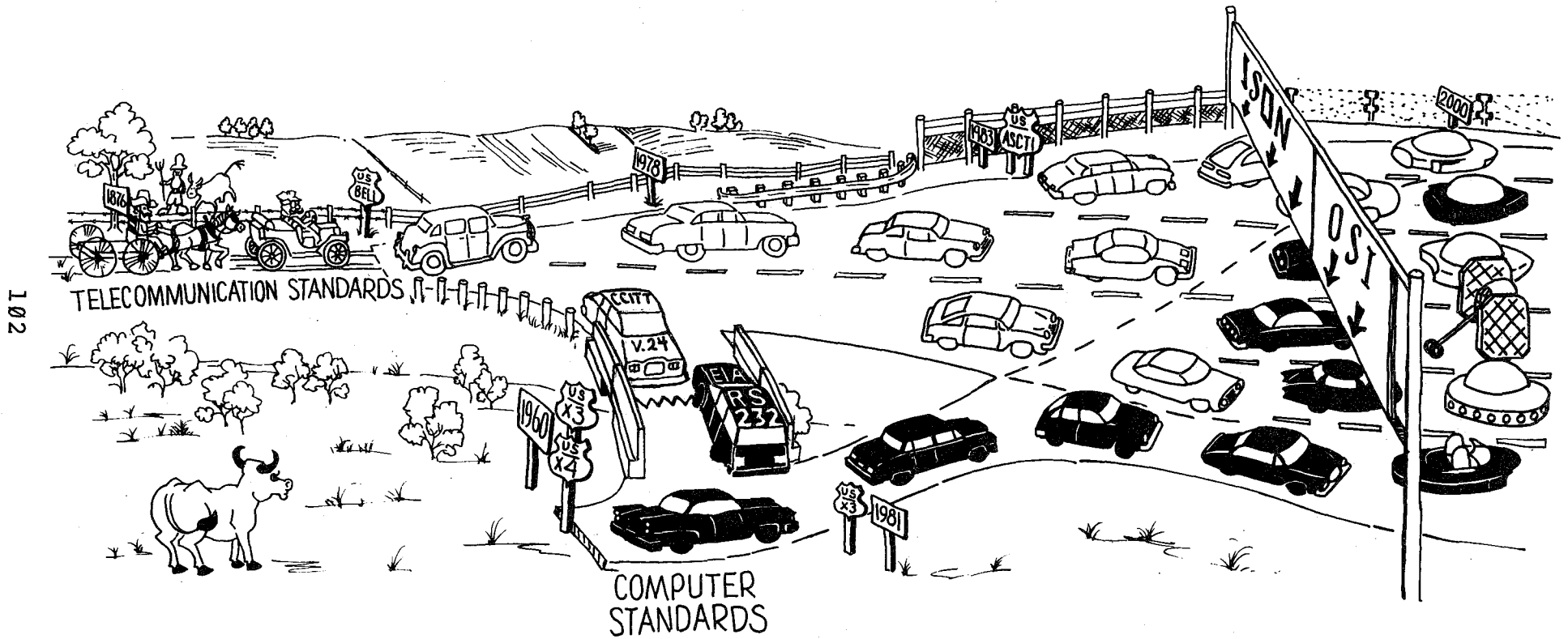
Figure 13. The independent development in the United States of telecommunication and computer standards (part A) and the merging efforts (part B).

Group in which to work out a unified position on ISDN technical matters being presented at international meetings. On April 4, 1984, the Technical Working Group of the U.S. CCITT ISDN JWP was formally converted to TSC T1D1. (The U.S. CCITT is discussed in Section 7.3.3.)

The U.S. computer industry's involvement in ISDN has been emerging in X3S3, particularly X3S3.7. See Section 8.3.4 for further discussion on ISDN-related efforts.

ANSI Activities in Telecommunications

The challenges facing the standards community in the telecommunication areas are not unrecognized by ANSI, although ANSI has not previously dealt specifically with American National Standards in telecommunications. ANSI has recently established a mechanism for a new field of studies by defining a Joint Telecommunications Standards Coordinating Committee (JTSCC) to deal with telecommunication issues. The JTSCC, responsible for facilitating exchange of information on ongoing and proposed standards projects, reports to two of ANSI's Standards Boards: Information Systems, and Electrical and Electronics. This new committee intends to coordinate the efforts of T1, EIA, X3, and IEEE.

Previous to the JTSCC formation, IEEE worked with ANSI to create a Coordinating Committee on Telecommunication Standards (CCTS), designed to report to ANSI's Electrical and Electronic Standards Board. The first report of this Committee was a 70-page compilation of the U.S. telecommunication standards developed by ASTM, EIA, Bell, FCC, IEEE, NFPA, Rural Electrification Association (REA), UL, and the U.S. Independent Telephone Association (USITA), among others (Cohen, 1983). The JTSCC will overtake the CCTS--being more comprehensive.

In summary, the formation of T1, the overlap of OSI and ISDN studies between the telecommunication and information processing groups, and the need for present and future coordination among T1, X3, EIA, IEEE on the national level, and ISO and CCITT (minimally) on the international level, are all contributing to the dilemmas facing the U.S. standards community at present. The eventual reorganization and adaptation of present committee structures is inevitable to prevent overlap and overkill. Ideally, the eventual solutions will offer a clear distinction of responsibilities and specific areas for coordination among the standards groups.

6. THE SIGNIFICANCE OF INTERNATIONAL STANDARDS

International standardization started in the telecommunication field 119 years ago (ITU), in the electrotechnical field 77 years ago (IEC), and in the technical fields as a whole 37 years ago (ISO). Twenty years ago international standardization was generally considered to be a slow, sure process, the domain of industry experts. Ten years ago international standardization activity began to accelerate, and the decade of the 70's and the early 80's have produced about 70% of the approximately 7,500 international standards now on the books (see Figure 14). What has happened to bring about such a radical change?

There are a limited number of worldwide factors generally proffered as the basic reasons for this change. Three of these reasons have already been considered in this report: the growth of consumer/user participation in the process, nationally and internationally; the prominence of safety aspects of standards and the resultant trend in Governments to reference standards, both national and international, in national laws and regulations; and new technology, accompanied by interdisciplinary solutions to advanced techniques.

Three other reasons, already referred to in this report, are developed below. Each of these indicates the need for nations to interconnect, exchange, or otherwise interrelate. They are:

1. tremendous growth in international trade;
2. new world markets, especially in the developing countries; and
3. the arrival of the "Information Age."

Although the material in this section refers most directly to the ISO and voluntary groups in general, most of it applies as well to the ITU/CCITT, a treaty, governmental organization (see Section 7.3).

6.1 The Changes Occurring in International Standards

The following words from the ISO Directives express the underlying philosophy of all international standards work:

> The social and economic long-term benefits of an International Standard should justify the total cost of preparing, adopting, and maintaining the standard. The technical considerations should demonstrate that the proposed standard is technically feasible and timely, and that it is not likely to be made obsolete quickly by advancing technology or to inhibit the benefits to users of technological advances (ISO, 1982b).

GROWTH OF INTERNATIONAL STANDARDS
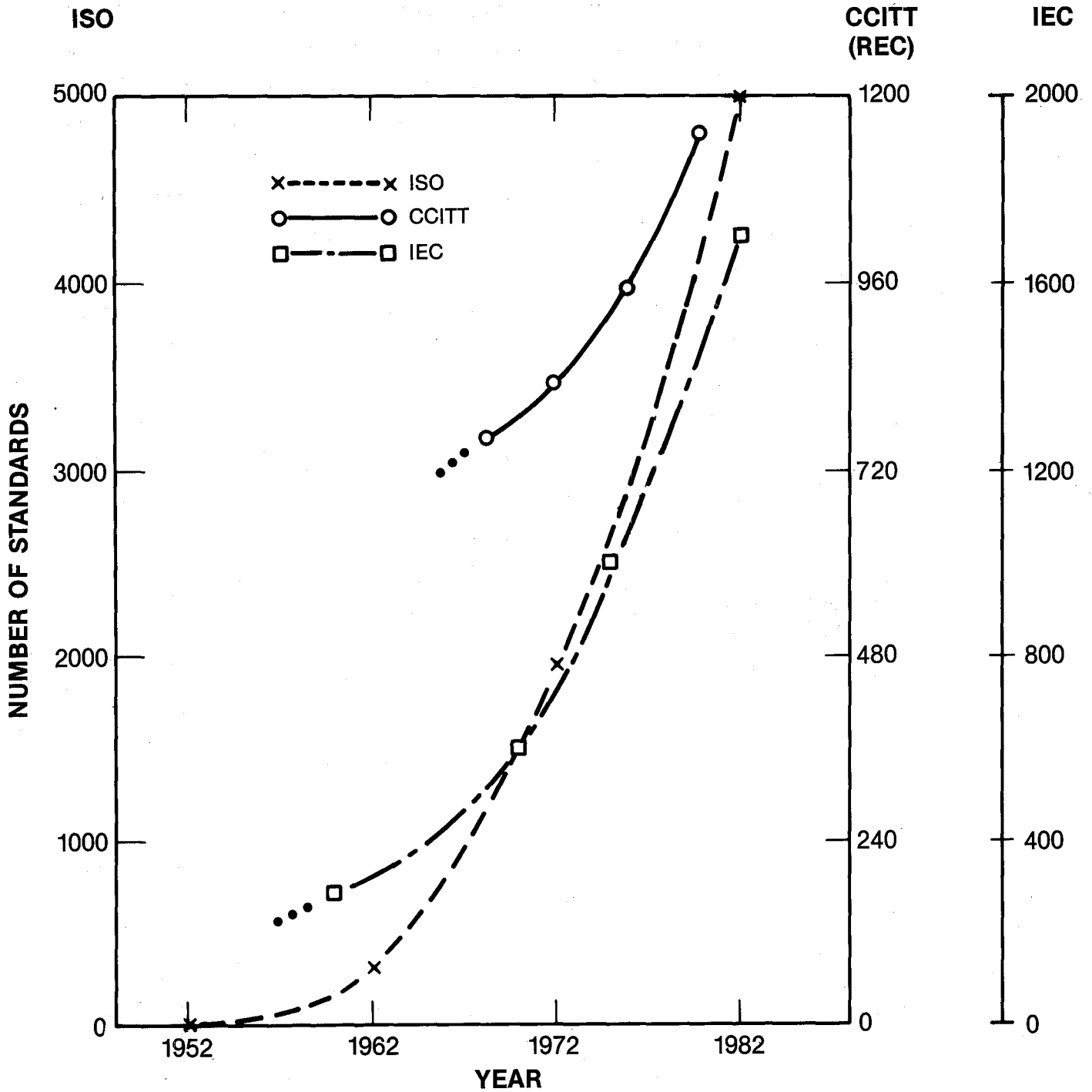
Figure 14. The growth of international standards development in ISO, CCITT
(Recommendations), and IEC. (Data gathered from various sources.)

However, the nature and extent of the international standard is currently in transition. The scope of such standards, until quite recently, was the "basic" standard, including fundamental technical requirements. In the case of telecommunication standards, the work was almost totally concerned with nation-to-nation network interconnection. Section 2.2.1 recognized the two concurrent, and somewhat related, changes taking place--the product-performance standard and the planned interdisciplinary system of standards.

6.1.1 The Product-Performance Standard

The first change is a response to increasing pressure from industralized as well as developing countries to take on projects that were formerly considered the prerogative of national standards, i.e., product-performance requirements. According to Olle Sturen, the Secretary-General of ISO, this change, in which increasing aspects of national standards now have to be evaluated by international groups, has raised two misgivings about the outlook for work at the international level. One is the fear that the procedural difficulties of standardization will become progressively more evident as the activity moves up the scale from local company standard, through national, to international standards. "This leads some people to think that efforts above a certain level are not worth the effort" (Sturen, 1981a). The other misgiving is that the technical scope must be very limited in the atmosphere of international collaboration, particularly in fields subjected to rapid technological development. This topic is dealt with further in Section 6.2.

6.1.2 The Planned Interdisciplinary System of Standards

The second change is the trend toward the integrated system of standards, particularly when required by integrated technologies. The move toward planned systems of standards, as exemplified by the ISDN, the OSI Reference Model, and the new work in Text Interchange, is producing a need for a level of cooperation among international groups that is of great concern to all involved in the effort. The internal coordination, liaison, and planning required in the interrelated activity necessary in today's efforts for the ISDN and OSI work substantiate Mr. Sturen's concern, as expressed in the following quotation:

> It is obvious that internal and external coordination, liaison, and planning are essential elements for any organization covering a large spectrum of interrelated activities. [B]ut, it is also true that an organization can plan and coordinate itself into paralysis

and this will be a clear danger in national and international standardization if we do not take the fundamental organizational steps required to deal with technology integration (Sturen, 1983).

6.2 The Changes Occurring in International Standardization

Related to the changes in the nature of the standards themselves is the radical shift occurring in the standardization process. Formerly (and to some extent still) international standardization served to achieve harmonization among the national functional standards of several countries. Traditionally, 10 or 12 national standards were brought to the international forum and a commonly agreed upon position, or "reactive" standard, was eventually developed. The century-old time-consuming committee/ballot structure, upon which all of the international organizations were developed, served this process well.

A different problem faces the international committee when only two conflicting national standards emerge, each of which is already in some use internationally. Various solutions have been found: the group decides to refrain from the formulation of an international standard; one national standard is chosen over the other; both are accepted as international standards; or a third standard is developed--either a combination of both, or one not aligned with either. The solution is not primarily technical, but rather economical and political. This suggests that the technical-committee approach may not be at all suitable for this kind of solution. The international organizations are all examining this problem.

Another situation, characteristic of rapidly developing technologies such as telecommunications and information processing, is the need for the international body to reach agreement on a standard before conflicting national standards have a chance to cause problems. This approach makes the international body the primary standards writer. In this "proactive" mode, the process is totally reversed: the international standard precedes the national standard. The committee method seems well suited to this approach, "but only if the procedure presently applied can be streamlined to meet the pressure for rapid results" (Sturen, 1982).

This "proactive" mode of international standardization produces a conflict in objectives for the industrialized countries in particular. One objective of the international effort is to establish the highest number of international standards for implementation worldwide. However, "the need to

produce high quality goods for domestic consumption means German [substitute national] standards must always be a few steps ahead of those produced on the international level" (ANSI Reporter, 1983c). There is no difficulty with the basic standards. The difficulties arise with standards for the design, performance and safety of complex products. The problems can be reduced, and often overcome, by producing standards that center on product performance, minimum specifications, and quality classification.

6.3 The Role of International Standards in International Trade

The potential role of national standards and regulations as technical barriers to trade between nations has received worldwide attention in recent years. This problem has been recognized since the beginning of the century by industries and individual exporters, and it has always been a driving force for international standardization efforts. National governments had never, until the 1980 GATT Standards Code, formally recognized the problem. Sweeping economic and geopolitical changes in the world today, accompanied by enormous growth in world trade, have caused nations to evaluate seriously the potential of internationally harmonized national standards to facilitate trade.

6.3.1 The Growth of World Trade

Recent years have witnessed an immense expansion in total world trade. In 1970, 12.5% of total world output was traded internationally; by 1980, that share had increased to 25%. Estimates today predict that by 1990, 33% of world output will be traded internationally and 80% of this will be derived from manufactured products (Zerlaut and Garner, 1983).

Reasons for this growth include the expansion of new markets in developing countries and the emergence of new nontraditional centers of economic activity (e.g., Singapore, Hong Kong). The United States is particularly affected by the increased presence of Japan and European countries in both new and traditionally U.S.-dominated markets.

The total market in world telecommunication equipment expenditures for the decade of the 80's, for example, will approach $640 billion (constant 1979 dollars), according to a recent study. "More is likely to be spent on telephone equipment during this one decade than was spent from the time the instrument was invented in 1876 up to 1980. Together, Europe and Asia will account for just over one half of the market" (Schiller, 1983).

The United States is more concerned than ever about export of goods and services, including those related to telecommunications, electronics, and computers. The problems of the changing international markets are of such consequence that "the future of U.S. industry, if not the very survival of segments of it, depends upon our ability to rapidly and forcefully deal with these changes" (Zerlaut and Garner, 1983).

6.3.2 International Standards Facilitate World Trade

One major dimension in world trade is the role played by international standards in facilitating trade. Differing national technical requirements have joined trade tariffs as critically important factors in worldwide marketing. When importing countries do not allow goods to clear customs unless the incoming products conform to the national standards of the importer, these standards assume the importance of government regulations because the regulations become technical barriers. Therefore, conflicting national standards and/or regulations may, and do, require the exporters to produce costly and unnecessary variants of the same product in order to market internationally.

International standards help to alleviate these problems. Agreed upon standards permit the buyer and seller to communicate in a common international language. Mutual application of standards, through certification, for example, helps to ensure that foreign products sold in the United States meet the same criteria as U.S. products.

The United States looks to have an active, productive part in the world trade of the future. In order for this to take place, U.S. companies must now involve themselves in domestic (and international) standards activities. Companies that have traditionally not marketed overseas can no longer afford the luxury of being indifferent to the domestic national standards activity. Only a strong domestic standards program that offers the international standards writer a clear picture of U.S. needs and positions can ensure a viable U.S. presence in current and future international standardization activities, which, in turn, will help determine future markets.

6.3.3 The GATT Standards Code and the United States

The General Agreement on Tariffs and Trade (GATT) is the basic agreement between nations that sets out the rules for the conduct and regulation of

world trade. Under the auspicies of GATT, there have been seven rounds of Multinational Trade Negotiations (MTN) since 1948.

During the most recent, the Tokyo Round (1973-1979), representatives from 99 nations sought not only to lower tariffs, the traditional barriers to world trade, but also to modernize government regulations and administrative practices that were becoming significant "nontariff barriers" to world trade. It had become recognized in the early 70's that the nontariff barriers, such as restrictive government procurement practices, import licensing procedures, and certain practices associated with product standards, had replaced tariffs as the major obstacles to world trade. Until 1973, GATT had no provisions on the trade effects of these barriers. The Tokyo Round Trade Agreements, especially the "Standards Code," specify the standards-related international obligations undertaken by countries signing each of the agreements. These obligations are now part of the international body of law regulating trade. In addition to creating new export opportunities for U.S. business, the Agreements established new trading rights and legal remedies that can be used by governments and businesses to secure access to foreign markets and to assure prompt investigation of unfair trade practices.

The GATT Standards Code

Among the many Codes and Agreements of the Tokyo Round is "The Agreement on Technical Barriers to Trade," popularly known as "The Standards Code," which became effective January 1, 1980. Its purpose is to eliminate the use of standards and certification systems as impediments to international trade by providing a vehicle for the signatories to work toward solutions for particular standards-related problems. While not attempting to cover standards activities that are the domain of national and international groups, the Standards Code does establish international rules for signatory governments, for the first time. It regulates the procedures by which standards and certification system are prepared, adopted, and applied, and by which products are tested for conformity with standards. Private- and public-sector standards, voluntary and regulatory, are subject to the Code's provisions.

By April 1983, 37 countries, including the United States and its major trading partners, had signed the Agreement. According to Sturen, "The Code is the most important result, so far, of . . . intergovernmental interest in voluntary standardization activities" (Sturen, 1980).

U.S. Implementing Legislation

Title IV of the Trade Agreements Act of 1979 implements the GATT Standards Code in the United States. Generally speaking, the Act mandates Code compliance by Federal agencies engaged in standards-related activities. It does not place specific obligations on state, local, or private groups, but expresses the following "sense of Congress" that they should comply: "no state agency and no private person should engage in any standards-related activity that creates unnecessary obstacles to the foreign commerce of the United States." To this end, on December 7, 1982, the International Trade Administration of the Department of Commerce, with the consultation of ANSI, issued "Voluntary Guidelines for State and Local Governments and Private Sector Bodies Engaged in Standards Development, Product Testing, and Certification Systems."

Four Government agencies have primary responsibilities in implementing the GATT Standard Code in this country. The Office of the U.S. Trade Representative (USTR) coordinates U.S. trade policies related to standards, and leads U.S. delegations, which include representatives of the Department of State, to international negotiations. The Departments of Agriculture and Commerce have established the required "Technical Offices" for agricultural and nonagricultural products, respectively.

The Trade Agreement Act calls for the responsible Government agencies to consult with the private sector for their technical and policy advice on the implementation of the Standards Code. To this end, IFAC was formed (see Section 5.1.2). This group is administered by the International Trade Administration in the U.S. Department of Commerce.

Procedural Guidelines of the GATT Standards Code

Both documents mentioned above support the procedural guidelines listed in the GATT Standards Code. (The Code includes Certification systems as well, but these recommendations are not included here.) The Code guidelines for standards are summarized below:

1. Standards are not to be prepared, adopted, or applied so as to create unnecessary obstacles to international trade.

2. Open procedures must be followed whenever a new or revised national standard or technical regulation is being drafted, unless based on international standards. According to these rules, for the first time in history the major U.S. trading partners are required (under most circumstances) to publish a notice of their proposed standards, to provide copies of these standards upon request, and to allow the

United States (and other signatories) to comment on them (see Section 4.3.3).

3. Whenever possible, standards are to be specified in terms of performance, rather than design or description characteristics.

4. Signatories are required to use relevant international standards, or parts of standards, as the basis for new national standards and regulations whenever appropriate. It therefore behooves signatories to participate in the preparation of international standards.

5. Each signatory must establish a standards inquiry point to make all standards information of the country readily available to the public, both foreign and domestic (see Section 4.3.3).

6. Upon request, signatories are to provide technical assistance to developing countries on mutually agreed terms and conditions to aid in the development of competent standards methods and organizations.

7. Specified settlement procedures to provide a number of modes and opportunities to resolve contentious issues.

The Significance of the GATT Standards Code

The Standards Code and subsequent U.S. legislation support and strengthen the major recommendations of both the National Policy on Standards and OMB Circular A-119. In particular, the Standards Code emphasizes the importance of regulators becoming more directly involved in the standards making process for the coordination, whenever necessary, between standards and technical regulations.

The Code also emphasizes the worldwide importance of U.S. voluntary standardization processes that follow the basic norms of the Code. Since the standards-setting processes of other countries have often been closed to suppliers from foreign countries, most signatory countries of the Code have had to amend their specific practices to conform to the requirements for open processes. This has opened the way for U.S. participation in the standards-setting activities of other countries. In 1982, for example, the Government of Japan announced that it would permit participants from other countries to serve on certain Japanese standards committees. Japan's purpose, according to ANSI, was "to further ensure openness in the formulation of standards—one of the requirements of the GATT Code" (ANSI Reporter, 1982).

In terms of international standardization, the Code offers the challenge for international product standards to be as complete and as good as the corresponding national standards and regulations so that individual governments will use the international standards. This should lead not only to a broader participation in the ISO and IEC work, but also to a wider

implementation of the international standards. In those cases where the national and international standards are identical, national standards institutes will be in a better position to ensure that its standards will be respected in technical regulations. The ISONET information centers, serving as the inquiry points required by the GATT Code (see Section 4.3.3), provide a valuable communication link between regulators and standardizers, because such coordination minimizes duplication.

Sturen, in addressing an ANSI Evaluation Update meeting, encouraged a closer cooperation--a better "climate"--between the standardizers and regulators of the world in these words:

> It is a secret to no one in this audience, that there has been a sort of competition (an element of suspicion) between those preparing regulations, and those developing voluntary standards. . . . I think that . . . the standardizers can make a very major contribution in providing the technical solutions that could be used by the regulators; . . . the regulators can help . . . , not only in the preparation of the standards, but also more important, in securing the implementation of International Standards through . . . technical regulations (Sturen, 1980).

6.4 The Developing Countries and International Standardization

One of the major problems facing all international groups worldwide is the role of the developing countries. This problem is escalating. In 1980, 70% of the world's population lived in nonindustrialized countries; by 1990 this number will have increased to 80%. Figure 15 highlights the differences between the 24 industrialized Organization for Economic Cooperation and Development (OECD) nations and the rest of the world.

The extent of the differences in technology between industralized and developing countries is also indicated by a few statistics taken from the telecommunication field. Eighty percent of the world's telephones are installed in 10 countries in North America and Europe, for a total population of about 750 million. The developing world has 7% of the world's telephones for a population of 2 billion. Only 15 of the 31 least developed countries have any television at all. Less than 6% of the inhabitants in countries with low and middle GNP have radio receivers, against 75% in developed countries. Also, for the developing countries, the availability of service is uneven; the broadcasting service is urban-oriented and the rural populations in many countries have little or no service (Naslund, 1983).

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GLOBAL VILLAGE
1981

POPULATION
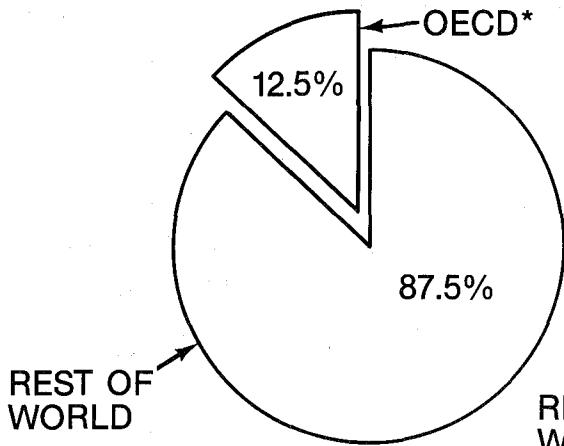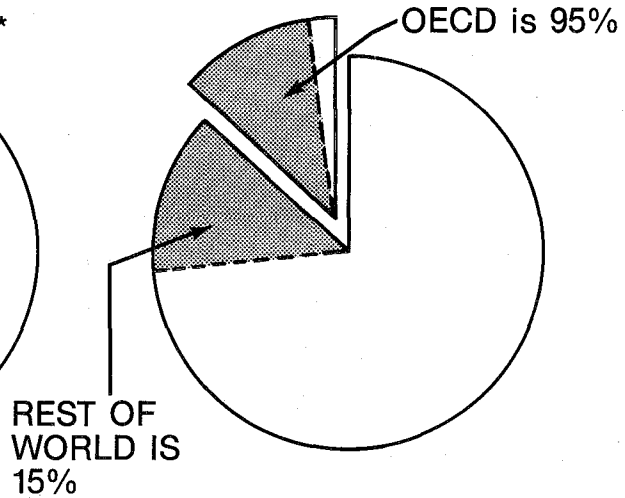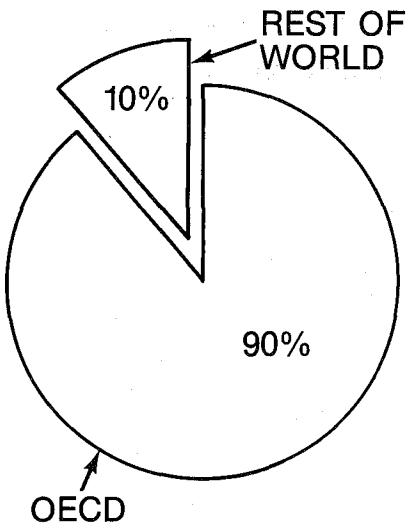
OECD*

12.5%

87.5%

REST OF
WORLD

LITERACY

OECD is 95%

REST OF
WORLD IS
15%

ENERGY CONSUMPTION

REST OF
WORLD

10%

90%

OECD

TELEPHONES

REST OF
WORLD

10%

90%

OECD

TELEVISION RECEIVERS

REST OF
WORLD

10%

90%
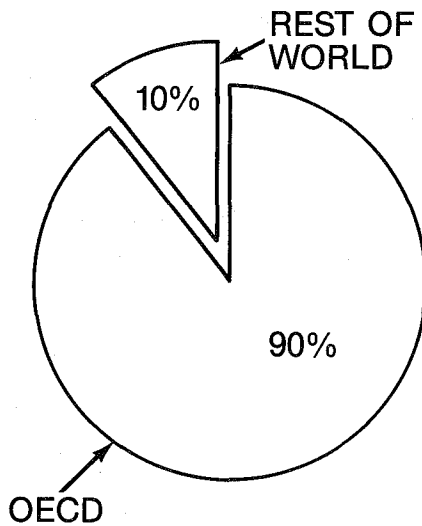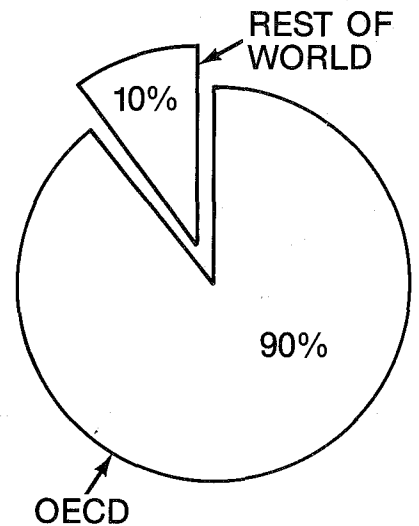
OECD

*OECD: Organization for Economic Co-operation and
    Development (composed of 24 developed nations,
    including the United States)

Figure 15.   Some differences between the 24 major industrialized nations and
        the rest of the world.

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When these same data are projected onto one international organization, the ITU (and CCITT), they translate into the fact that 15% of the 157 ITU member nations control 90% of the world's telecommunication resources. These 24 nations are interested in rapid development of new standards to begin deployment of complex international telecommunication interconnections for the 21st century; the 85% are interested in rapidly catching up with 20th (and in some cases, 19th) century technology. These vastly divergent goals--genuine conflicts of interest--are the crux of the kinds of problems facing ISO and IEC, as well as the ITU.

Organizations that were founded by and supported by the industrialized countries for decades are now faced with these problems as the developing country membership continues to increase and represents the majority. The issues of greatest concern include the degree of responsibility of the industrialized countries to the developing nations for technology transfer and technical assistance, the role of the developing countries in the standardizations efforts, and the changes necessary within the international organizations to handle the solutions.

The resolution of these issues is the greatest challenge yet faced by the standardization community. The GATT Standards Code recognized these problems. Analysis and suggested solutions to these problems are well beyond the scope of this report. In keeping with the purpose of this report, this general overview is presented for the reader interested in understanding the over-all milieu of international standardization.

6.4.1 The Developing-Country View of International Standards

Industrialized and developing countries view international standards from different perspectives based on different views of reality. To the industrialized societies, long involved in the effort, standards are tools used to bring order into an ongoing industrialization process. To the developing countries, for whom the standards come ready-made, standards are instruments used as the basis for industrialization itself: the standards are tools for technological and economic development, and for the transfer of technology from the industrialized world.

For manufacture of their own goods, the bulk of already developed basic international standards serves the needs of the developing countries well. The application of these universally applicable basic standards by the developing countries, however, often requires assistance. The ISO, ITU, and

IEC all have groups and programs to address these educational problems, in connection with actual technical assistance.

Developing countries are demanding product standards as discussed in Section 2.1.1. They need these for development of exports and also to protect themselves, for example, against unknowingly importing incompatible technical equipment from different supplier countries. Because most developing countries do not yet have the resources--money and expert personnel--needed to develop a national standards organization, many must rely on international standards from which to determine import criteria and their own appropriate standards. They need the standards guidance of highly industrialized countries to guide them to a knowledge of the level of technology on the competitive world market.

Two examples of concerted U.S. efforts to aid the developing countries by means of technical education (and then perhaps standards involvement) are the newly formed U.S. Telecommunication Training Institute (USTTI), and the model regional Telecommunication Training Center set up by the U.S. Telecom Suppliers Association (USTSA). Both programs started in 1983.

The USTTI, a nonprofit independent corporation, is a joint venture between U.S. telecommunication firms and the Government (including, for instance, the FCC and the National Telecommunications and Information Administration [NTIA]). The purpose of the corporation is to share advances in telecommunication technology with developing countries. If its first year (1983-84) is successful, "USTTI expects to continue as a permanent institute, and the government's organizational commitment to the program will slowly be phased out" (Minkel, 1983).

The training center, located at Texas A&M University, was established to "train staff from abroad in the job of training centre design, implementation, operation, administration and the instruction of trainees" (Telecommunication Journal, 1983a). The necessary equipment for the program is contributed by U.S. manufacturers.

An example of a worldwide, ITU-sponsored program is the Independent International Commission for World-Wide Telecommunications Development, mandated at the 1982 Plenipotentiary in Nairobi. The Commission was created in recognition of:

> . . . the fundamental importance of telecommunications for the national development processes . . . and the somewhat paradoxial situation of the opportunities which new telecommunication

technologies offer to enable low-cost services to any point on earth and the widening of the gap between countries which are well equipped . . . and those which are struggling desperately to programme, install and maintain even small capacity telecommunication systems (Butler, 1983a).

The 17 members of the Commission are internationally recognized and serve on a voluntary basis. They are considering the most cost-effective way in which the ITU could stimulate and support the range of activities that might be necessary to achieve a more balanced expansion of telecommunication networks. This work to be finished in 1985 is intended to lead to progressive achievement of self-reliance in the developing world and the narrowing of the gap between the developing and developed countries (Telecommunication Journal, 1983a). In the words of R. E. Butler, Secretary-General of the ITU, this activity suggests "that we are on the road to success to find new methods and a strengthening of co-operation which would bring about an accelerated development of telecommunications and speedier and more effective transfer of technology and its practical application for all to make 'One world, one network' a reality during this decade" (Butler, 1983b).

6.4.2 Developing-Country Participation in International Standardization

Developing countries wish to participate in the process of new standards development although most are just in the process of producing an expert corps of technical people from which to draw. Those countries that have national standards bodies seldom have enough resources left for active participation at the international level.

The immediate type of collaboration of the developing countries in standards work appears tied to the involvement of international standards groups in the extended product standards. The consequence of this approach is the need to provide a graded series of requirements for procedures and products--within the framework of a uniform system--so that developing countries can make adjustments according to their economic and technical conditions. (Of course, this applies as well to the developed countries if they rely on the international standard.) This may sometimes call for the publication of two (or more?) parallel standards.

All three major organizations have already been faced with the dilemma of parallel standards, and in the past this was largely considered a failure. However, the expansion of goals from harmonization to primary writing requires a rethinking of this. Sturen, speaking of the ISO, has said:

Actually, in ISO we have experienced this need for parallel standards before: for 20 years we have had two systems of screw threads standardized by ISO.

The example of screw threads tells us that no standard--international or national--is ever the last word in sophistication and every published standard, whether national or international, simply represents the most recent phase in a process of refinement that has gone on for years. I do not think it too hard to envisage an endeavor that takes account of temporary economic conditions, provided the line of development is toward the same end. If we can establish the first rung of the ladder wherever we have any lead as to the requirement for a standard in a developing country, then we have a product that can be improved (Sturen, 1981a).

It is in this respect that the traditional one-way flow of standards traffic from industrialized to developing countries can move toward a two-way flow and include true participation of all concerned. Representatives of the developing countries can, in certain cases:

. . . spell out the specific needs of these countries, and the industrialized countries will be invited to provide the appropriate response in areas where they, and only they, have the expertise. In other cases the presence of representatives of developing countries at an ISO or IEC meeting may open up a real dialogue which, it is hoped, will result in technical solutions beneficial to all the parties (Sturen, 1981a).

The dilemma facing the international organizations is how to organize the limited resources so that ways and means can be found that on the one hand do not delay standardization as needed by industrial nations and on the other hand establish the product standards adjusted to the various conditions of the developing countries. Again, in the words of Sturen:

For the implementation of this two-way traffic it is not enough to secure the necessary financial means for developing country participation, which seems to be forthcoming, but also, and above all, the understanding and readiness of the standards experts from the industrialized countries as well as the standardizers from the developing countries to make their contribution both by correspondence and at international meetings (Sturen, 1981a).

6.5 The Effect of the Information Age on International Standardization

The world, as it enters into the Information Age, must deal with the internationalization of communications and information exchange. It appears today that the efficient, beneficial use of international computer networks, already part of the pattern of dramatic change in global communications, will increasingly depend upon the developing standards based on the OSI Reference

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Model. The global integration of the data and voice services in a totally digital environment depends upon the standards being developed relative to the ISDN. Furthermore, the necessary interworking of telecommunications and information processing requires that the ISO and the CCITT share some of these efforts, as they are doing. United States participation in these organizations is of critical importance to our future role in the world economy.

The major international standardization efforts relating to information, in addition to the ISDN and the OSI Reference Model are: Text Preparation-Interchange, Local Area Networks (LANs), Text Processing (e.g., videotex and teletex), Certification, Ergonomics, Office Equipment and Supplies, Product Safety, and Programming Languages. These activities have major participation by ISO, CCITT, IEC, and the European Computers Manufacturing Association (ECMA). (ECMA, formed in 1961, is a regional standards organization consisting of companies, some multinational, that develop, manufacture, and market data processing equipment in Europe. It is exclusively dedicated to the cooperate development of standards applicable to computer technology.)

Although it is true that the major developments permitting the widespread growth of communications were a product of the United States, it is also true that many of the industrialized nations are now equally involved in establishing advanced communication networks. The rapid changes represent a strategic new element in the American global equation.

There are three major trends easily identified on the left side of this global equation. The first of these is the rapid, head-long growth in world communication and information resources. For example, the volume of communication traffic is doubling every 6 years. Furthermore, telecommunications is becoming more economical as the traditional ways of transferring information (mail services, newspapers, etc.) become more expensive. Whatever measures for analysis are used, communications and information emerge as major growth sectors that continue to be uniquely immune from the economic turbulence affecting other industries in recent years. In fact, "telecommunications is one of the few sectors which promises further development, economic growth, and technical progress throughout the world" (Miller, 1983).

The second trend influencing American interests are the changes occurring in the geographical pattern of global communications. Twenty years ago, volume was relatively low, and was confined largely to the North Atlantic area

(and Japan). Today, economics, politics, and technology are pulling these patterns into different shapes.

The third significant trend affecting international communications is the threat of political restrictions by various governments on the unified growth of the world information system. Although the scope of this report does not permit exploration of this critical topic, it is of great importance that information--the growth of and the storage of--is viewed as a political, economic, and cultural force. A new concept of information sovereignty has emerged: "the right of a society to protect itself against what it regards as unwarranted intrusion by outside information and communication influences" (Miller, 1983). This perception is a potentially serious problem for the United States that favors an open global information pattern. The reader interested in the effects of such issues on the International Telecommunication Union (ITU) is referred to Butler (1984).

The interrelation of such variables as national idealogy, government policy-making organizations, information policy, technology, the marketplace, and the information infrastructure has been represented in the form of a process model. Such a model attempts to show that the social impact of technology is a process that begins with a society's national ideology. The interested reader is referred to Salvaggio (1983) for models representing the United States and Japan, in which the conclusion is reached that no two models will ever be the same.

The product side of the new American global equation in communications will be largely determined by today's standards, influenced by all the reasons listed above, and by many others affecting most aspects of U.S. commerce. It is, therefore, critically important for U.S. interests to be represented by strong, knowledgeable U.S. participants in the key international standards organizations. As the world continues to shrink through communications the need for U.S. participation in international standards organizations--whatever the shape of the future--will only expand.

7. INTERNATIONAL STANDARDS ORGANIZATIONS AND STANDARDS DEVELOPMENT

The three major international standards organizations are the International Organization for Standardization (ISO), the International Electrotechnical Commission (IEC), and the International Telecommunication Union (ITU). The first two are voluntary nontreaty organizations; the third

is a United Nations-related, governmental treaty organization. Even so, the worldwide implementation of the international standards of the ISO and the IEC and the Recommendations of the ITU all share a voluntary application. In all cases, international standards can really have no other status than "recommended standards" since they only become national "standards" when declared so by a responsible national body. The general background, organization, and working methods of these three international groups are discussed below. The role of ANSI in international standardization is discussed. The relationship of ASC X3 and its subcommittees (i.e., technical committees) to the ISO TC97 and its subcommittees is outlined.

7.1 The International Organization for Standardization (ISO)

The ISO is a nontreaty, voluntary international organization of 89 member nations. Founded in 1946, ISO continues the work started in 1926 by the International Federation of National Standardization Associations (ISA), disrupted by World War II (see Section 3.2). The ISO develops, coordinates, and promulgates international standards (over 5,000 to date) that facilitate world trade, contribute to the safety and health of the public, and help protect the environment. ISO standards cover almost all fields except electrical and electronic engineering (work of the IEC). The corollary objective of ISO is to develop worldwide cooperation in the sphere of intellectual, scientific, technological, and economic activity.

7.1.1 Membership

Although ISO is a nongovernmental organization, more than 70% of the ISO member bodies are governmental standards institutions or organizations incorporated by public law. Most of the remainder have close links with the public administrations in their own countries. However, reflecting the voluntary nature of U.S. standards, the U.S. member body is ANSI.

ISO has two categories of membership. In the first category, full membership, there are 72 national standards organizations. These member bodies are entitled to full participation, exercise voting rights on any technical committee, are eligible for Council membership, and have seats in the General Assembly. Although ISO membership represents almost 95% of the world's industrial production, only 36% (26 of 72) of the voting members are

from industrialized countries. Traditionally, ISO (like CCITT and IEC) has had a preponderance of European leadership.

The second category of ISO membership includes 17 "correspondent" members that are mainly governmental institutions in developing countries that do not as yet have national standards organizations. These members do not take an active part in the technical work, but are entitled to be kept fully informed about the work of interest to them. They have no vote but may attend the General Assembly as observers.

More than 400 international organizations have liaison status with ISO, and these organizations include IEC, CCITT, and all United Nations (UN) specialized agencies working in similar fields. ISO has consultative status (category I) with the UN Economic and Social Council (ECOSOC) and equivalent status with nearly all other bodies and specialized agencies in the UN system (ISO, 1983a).

7.1.2 Organization and Technical Work

The general ISO organization, centered in Geneva, Switzerland, is depicted in Figure 16. The General Assembly, which meets every three years, makes the basic decisions. The 12th General Assembly met in Toronto, Canada, in 1982. The Council, the 19-member "Board of Directors," meets yearly and administers the ISO operation. The Council is assisted by an Executive Committee (EXCO), which makes policy recommendations and serves as a finance committee. One of seven advisory committees to Council is the Planning Committee (PLACO), which advises the Council on the organization, coordination, and planning of the technical work. Staff support is provided by a Central Secretariat (technical coordination, editing, ISONET, production, translation, etc.). The Central Secretariat acts as secretariat to the Council and to the Council committees and their subsidiary bodies.

The technical work of ISO is undertaken by technical committees (TC) and their subcommittees (SC) and working groups (WG), all subject to the general authority of the Council. The TCs are established as needed, and are numbered chronologically from TC1 (1947), "Screw Threads," to TC184 (1983), "Industrial Automation Systems." When a TC is dissolved, its number is not allocated to another TC.

Every member body may choose to be represented on any TC or SC. Member bodies that take active part in the committee work are designated "P" (participating) members; the representatives have an obligation to vote and

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION
(ISO)

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┌─────────────────────────────────────┐
│         GENERAL ASSEMBLY             │
│ Representatives of all Member Bodies │
│ Meets every 3 years                  │
│ Makes basic decisions                │
└─────────────────────────────────────┘
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ADVISORY COMMITTEES
1. Planning
2. Certification
3. Consumer Policy
4. Development (for Developing Countries)
5. Information
6. Reference Materials
7. Standardization Principles

COUNCIL
President & Representatives of 18 Member Bodies

Meets once a year

Administers ISO operation

EXECUTIVE COMMITTEE
Vice President & representatives of 9 Member Bodies

Assists Council and acts as finance committee

GENERAL SECRETARIAT
Secretary General & Support Staff

Acts as Secretariat to council & all Council Committees & their subsidiary bodies

TECHNICAL COMMITTEES
163 Technical Committees
(and over 2000 subcommittees & working groups)

Figure 16. The structure of the International Organization for
Standardization (ISO).

attend meetings whenever possible. Member bodies that choose only to keep themselves informed of the TC activity are called "O" (observer) members; the representatives of the "O" members have the right to attend meetings but may not vote. Correspondent members of ISO may register as observers.

Each TC has a secretariat (a participating member body) that is responsible to Council and to the members of the Committee for all the activities of the TC including oversight of subcommittees and working groups. Each subcommittee also has its own secretariat responsible to the parent TC and to the members of the SC for all the activities of the SC, including its working groups. For each WG, an individual convenor is appointed by the parent committee.

Over 20,000 volunteers worldwide (ISO, 1983a) participate in 163 technical committees and some 2,000 subcommittees and working groups. The number of ISO technical meetings per day is estimated at about seven worldwide. The cost of one large international meeting can easily run over $1 million.

The technical committees that are most relevant to this report are TC46: (Automation and Library Science), TC68 (Banking Procedures), TC97 (Information Processing Systems), TC154 (Documents and Data Elements in Administration, Commerce, and Industry), TC159 (Ergonomics), and TC184 (Industrial Automation Systems). In the following section, only TC97 is discussed. Section 7.5.5 includes the relationship of ASC X3 to TC97.

7.1.3 ISO TC97: Information Processing Systems

TC97 is an example of a large, high-technology technical committee as well as the ISO TC most closely related to telecommunications. It is unique among ISO committees because of its rapid growth field. Two international standards developed by TC97 were published in 1982; 13 were published in the first 6 months of 1983. This section presents the history and structure of TC97, and includes a discussion on the 1984 TC97 restructuring.

In 1961, TC97--"Computers and Information Processing"--was formed with ANSC X3 as its model and with ANSI as its secretariat. This committee dealt with computers and associated systems and related peripheral equipment devices and media.

In 1981, TC97 was merged with TC95 "Office Machines." The TC95, also formed in 1961, had completed a considerable portion of its originally mandated work, and was becoming involved in technologies closely allied with

computer technology and electronic information management. According to
Rankine (1982), chairman of TC97, the following three reasons dictated the
merger:

1. the merger of communications and information systems technology;

2. the growing interrelationships of various kinds of computer and
   information processing applications; and

3. the common use being made of major telecommunication facilities and
   the common telecommunication requirements.

The benefits that apparently accrued to ISO by such a merger included the
decrease in the overhead costs and the establishment of a single framework in
which users, manufacturers, governments, and telecommunication agencies could
puruse standardization in the area of information systems. In addition, the
consolidation of efforts into one TC placed ISO in a position to better deal
with the coordination of its work with CCITT and IEC.

In anticipation of a rapid growth in Industrial Automation Standards, two
of the TC97 subcommittees--SC8, (Numerical Control of Machines), and SC9,
(Programming Languages for Numerical Control)--were merged to form TC184,
(Industrial Automation Systems) in March 1983. The five subcommittees of
TC184 are: Numerical Control of Machines, Industrial Robots, Non-Device-
Specific Application Languages, External Representation of Product Definition
Data, and Requirements for Systems Integration. The United States, through
ANSI, has the Secretariat for the last two.

Figure 17 lists the 16 subcommittees (and secretariats) of TC97 according
to its June, 1984 structure. The United States had 50% of these secretariats,
as well as the TC secretariat. The figure also indicates the TC97 member
countries and the internal and external liaisons supported by TC97 and its
subcommittees.

Subcommittees 6, 16, and 18, "Data Communications", "Open Systems
Interconnection", and "Text Preparation and Interchange", are of particular
importance in this report. Subcommittee 18 is one of the three subcommittees
in which the work of TC95 and TC97 was merged. The working groups of these
three Subcommittees are listed in Table 5.

The TC97 was restructured in June, 1984 to provide more manageable
programs, better organization of its technical work, greater integrity for
areas of work, and better interface with organizations external to ISO (e.g.,
IEC and CCITT). The modified scope of TC97 is:

ISO TC97

Information Processing Systems
UNITED STATES

| SC1 Vocabulary FRANCE | SC 2 Character Sets & Coding FRANCE | SC 5 Programming Languages UNITED STATES | SC 6 Data Communications UNITED STATES | SC 7 Documentation of Computer-Based Systems SWEDEN | SC 10 Magnetic Disks GERMANY |

| SC 11 Flexible Mag. Media. Digital Data Interchg. UNITED STATES | SC 12 Instrumentation Magnetic Tape UNITED STATES | SC 13 Interconnection of Equipment GERMANY | SC 14 Representation of Data Elements UNITED STATES | SC 15 Labeling and File Structures UNITED KINGDOM | SC 16 Open Systems Interconnection UNITED STATES |

| SC 17 Identification & Credit Cards UNITED STATES | SC 18 Text Preparation & Interchange UNITED STATES | SC 19 Office Equipment & Supplies ITALY | SC 20 Data Encryption UNITED KINGDOM |

INTERNAL LIAISONS

ISO TC's:

TC 6	Paper, Board & Pulps
TC 6/SC2	Test Methods and Quality Specifications for Paper and Board
TC 8/SC15	Computer Applications for Shipbuilding
TC 37	Terminology
TC 39	Machine Tools
TC 46	Documentation
TC 68	Banking Procedures
TC 68/SC1	Bank Data Interchange
TC 68/SC2	Bank Operations
TC 68/SC3	Terminology
TC 145	Graphic Symbols
TC 154	Doc'n. and Data Elements in Admin. Commerce & Industry
TC 159	Ergonomics
TC 159/SC2	Ergonomics Requirements to be Met in Standards
TC 159/SC5	Ergonomics of the Physical Environment

ISO/TC97 MEMBER COUNTRIES

P-Members	O-Members
Canada	Australia
China	Austria
Czechoslovakia	Belgium
Finland	Brazil
France	Bulgaria
Germany	Chile
Hungary	Denmark
Ireland	Greece
Italy	India
Japan	Israel
Netherlands	New Zealand
Poland	Norway
Romania	Pakistan
Spain	Peru
Switzerland	Portugal
Sweden	Rep. of South Africa
United Kingdom	Tanzania
USA	Turkey
USSR	Venezuela
	Yugoslavia

EXTERNAL LIAISON

| CCE— | Commission of the European Communities |
CCITT—	International Telegraph & Telephone Consultative Committee
ECMA—	European Computer Manufacturers Association
EWICS—	European Workshop in Industrial Computer Systems
IEC/TC 74—	Safety of Electronic Data Processing Equipment and Office Machines
WMO—	World Meterological Organization

Figure 17. The organization of ISO TC97, "Information Processing Systems," before the June 1984 restructuring.

Table 5. The Structure and Secretariats of TC97
Subcommittees 6, 16, and 18 (as of June, 1984)

SG	WG	Title	Secretariat
6		DATA COMMUNICATIONS	United States
	1	Data Communications Control Procedures	United States
	2	Public Data Networks	United Kingdom
	3	Physical, Functional, and Electrical Interface Characteristics	Germany
16		OPEN SYSTEMS INTERCONNECTION	United States
	1	OSI--Reference Model	France
	4	OSI--Application & System Mangmt	Japan
	5	OSI--Application & Presentation Layers	United Kingdom
	6	OSI--Session & Transport Layers	United States
18		TEXT PREPARATION AND INTERCHANGE	United States
	1	User Requirements	Italy
	2	Symbols & Terminology	Japan
	3	Text Structure	United Kingdom
	4	Procedures for Text Interchange	France
	5	Text Preparation and Presentation	Canada

Standardization, including terminology, in the area of information processing systems, including but not limited to personal computers and office equipment (ISO, 1984).

In the restructuring, the 16 resultant SC's are organized into three groupings: Application Elements, Equipment and Media, and Systems. The third grouping, Systems, includes the former SCs 2, 5, 6, 16, and 20. Table 6 lists the SCs in the Systems grouping, and gives their present titles.

In the remainder of this report, draft proposals and draft international standards are referred to the SCs as they were established before the restructuring. The interested reader may obtain more information on the TC97 restructuring from ANSI.

Table 6. The TC97 Subcommittees in the "Systems" Grouping
            after Restructuring

SC 2 - Character Sets and Information Coding
SC 6 - Telecommunications and Information Exchange Between Systems
SC18 - Text and Office Systems
SC20 - Data Cryptographic Technique
SC21 - Information Retrieval Transfer and Management for Open
        Systems Interconnection
SC22 - Application Systems Environments and Programming Languages

7.1.4 Development of ISO Standards

The development of an ISO International Standard from the first proposal of the idea to the standard's publication involves seven clearly defined stages. This procedure ensures that the final result is acceptable to as many countries as possible.

Each stage is briefly described below (the time limits offered are the minimum time in which voting could be accomplished, and amendments require extended times):

Step 1. The new work item (NWI) is included in the program work of a TC. The initial document, called a "working draft", must be circulated among the appropriate members (TC, SC, or WG) with a view to the subsequent presentation of a "Draft Proposal" (DP). The circulation time for the first DP is three months. The DP must have "substantial support" from the P-members of the TC.

Step 2. The DP is registered at the Central Secretariat within 2 months of final approval by the TC.

Step 3. The Central Secretariat registers the draft proposal as a "Draft International Standard" (DIS) after checking and editing to ensure conformity with ISO Council directives.

Step 4. The DIS is approved by the member bodies of ISO within 6 months from distribution by the Central Secretariat. The DIS must receive a majority approval by the TC members, and 75% of all voting members. Two or more negative votes receive special consideration.

Step 5. The approved DIS and revision are returned within 3 months to the Central Secretariat for submission to the Council.

Step 6. The DIS is accepted by Council as an International Standard (IS).

Step 7. The IS is published by ISO (ISO, 1982b).

The member bodies are responsible for the distribution of ISO standards within their own countries. In the United States, ANSI is the sole source of these standards.

ISO's governing Council has recently approved, for experimental use, two new "Fast Track" procedures for accelerating the approval and availability of needed ISO international standards. Both procedures permit adoption of standards developed outside ISO technical committees.

One, for standards needed by rapidly developing technologies, permits any participating member of an ISO TC to propose an existing national, regional, or de facto standard as a DIS.

> The proposed standard must be well known, of high technical quality, and free of significant technical issues that require resolution. If there is no significant objection from P members of the technical committee, the Central Secretariat will circulate the document for combined P member and ISO member body vote on approval, on a "yes" or "no" basis. Proposals for changes are not permitted under this method (ANSI Reporter, 1984b).

The TC97 was specifically requested by the Council to apply this process on an experimental basis.

The other accelerated procedure concerns ISO's adoption of standards developed by other international standardizing bodies.

> For their standards to be eligible, these organizations must accept members from all countries and have technical expertise comparable to ISO's. The procedure calls for standards of such groups to enter the ISO process as Draft International Standards for circulation by the Central Secretariat to member bodies for a vote on a "yes" or "no" basis.

There are several ISO publications also available from ANSI that provide constantly updated information on ISO standards. These include:

1. ISO Catalogue: list of all published ISO standards (yearly).

2. ISO Technical Programme: list of all DIS (twice yearly).

3. ISO Standards Handbooks: 22 books of standards compiled according to technical fields. The following are of particular interest in this report:

   Handbook No. 8. Data Processing--Hardware (1982)
   Handbook No. 9. Data Processing--Software (1982)
   Handbook No. 10. Data Processing--Vocabulary (bilingual, 1982).

4. ISO Bibliographies: 22 books of International Standards and Draft International Standards in given fields and, where appropriate, a selection of relevant formative documents produced by other international organizations. Bibliography No. 16 is "Computers and Information Processing."

In addition, the ISO Bulletin, published monthly in English and French by the Central Secretariat, lists Draft Proposals and Draft International

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Standards progress, and includes deadline dates for comments where applicable. The ISO Bulletin carries articles and features on general ISO news and TC updates.

7.2 The International Electrotechnical Commission (IEC)

The IEC is, like ISO, a nontreaty, voluntary international standards organization. The IEC was formed in 1904 (see Section 3.1). The founders united to prevent the kind of divergence in national electrical standards that had already resulted in European nations operating electrical systems at 220 V while North American nations operated them at 115 V.

The standardization work includes topics such as universal technical language for definitions, electrical and electronic symbols, and electrical units; test methods; system characteristics such as voltages, frequencies, and tolerances; dimensional requirements and tolerances of electrical and electronic components and equipment; and universal electrical safety requirements of all kinds.

The operational structure of IEC somewhat resembles that of the ISO. The differences include the IEC General Assembly that takes place yearly and greater centralization of the IEC activities. This latter leads to many minor differences in document flow and work structure.

7.2.1 Membership

The IEC has 44 member nations, representing 80% of the world's population and 95% of the world's electrical consumption. Each member is a National Committee representing its country's interest in IEC's electrical/electronic standards activities.

The United States is represented by the U.S. National Committee (USNC), established in 1907, which is part of ANSI. The USNC is composed of representatives from 22 organizations (trade associations, professional societies, Government organizations, testing laboratories, etc.), plus the U.S. chairmen and secretaries of IEC committees, and about 100 technical experts. It operates through an elected 15-member executive committee and 172 advisory groups paralleling IEC committees and subcommittees. The chairman of each advisory group is called the "Technical Advisor" and is a voting member of the USNC. It is the job of the Technical Advisor to form the U.S. positions through consultation with the Advisory Group and to see that these positions are effectively presented at the international meetings.

7.2.2 Organization and Technical Work

The general organization of IEC, with headquarters in Geneva, is depicted in Figure 18. The operations are directed by the Council and headed by the IEC President. Council membership consists of the President (or representative) of each of the 44 National Committees plus several other past and current IEC officers. The Committee of Action functions like an Executive Committee, managing the technical work of the Commission. The Central Office provides staff support. The advisory committees, very few in number, are formed to advise the Committee of Action on special questions that cannot be dealt with in the ordinary TC structure.

One such committee is the Advisory Committee on Electronics and Telecommunications (ACET), composed of representatives from about 20 of the related Technical Committees. The ACET has two major functions. First, it makes recommendations to the Committee of Action on the allocation and coordination of IEC TC work on electronics and telecommunications and on the liaison with other IEC TC's and with other international bodies such as the ITU and ISO. Second, ACET advises the technical committees directly in the interpretation of their scopes of action.

In 1981, the IEC Information Technology Coordinating Group was established with the following objectives:

1. To organize coordination of the IEC work with work of other international bodies that operate in the field of information technology—primarily CCIR, CCITT, and ISO.

2. To coordinate work of IEC technical committees and subcommittees that relates to information technology to ensure that they do not overlap and that needs for standards do not go unfulfilled.

The IEC cooperates closely at the policy and technical levels with more than 100 governmental and nongovernmental international and regional organizations, including the United Nations.

The technical work of the IEC, like that of ISO, is performed through technical committees and subcommittees. Committee participation is open to all members. Each TC and SC has a secretariat who is one of the participating members. At the beginning of 1983, there were 72 technical committees and 132 subcommittees (IEC, 1982). The secretariats of these committees are distributed among 23 member nations. The U.S. National Committee, through ANSI, has the secretariat for 15% of the IEC Committees. These committees are assisted by hundreds of small, temporary working groups of specialists.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION
(IEC)
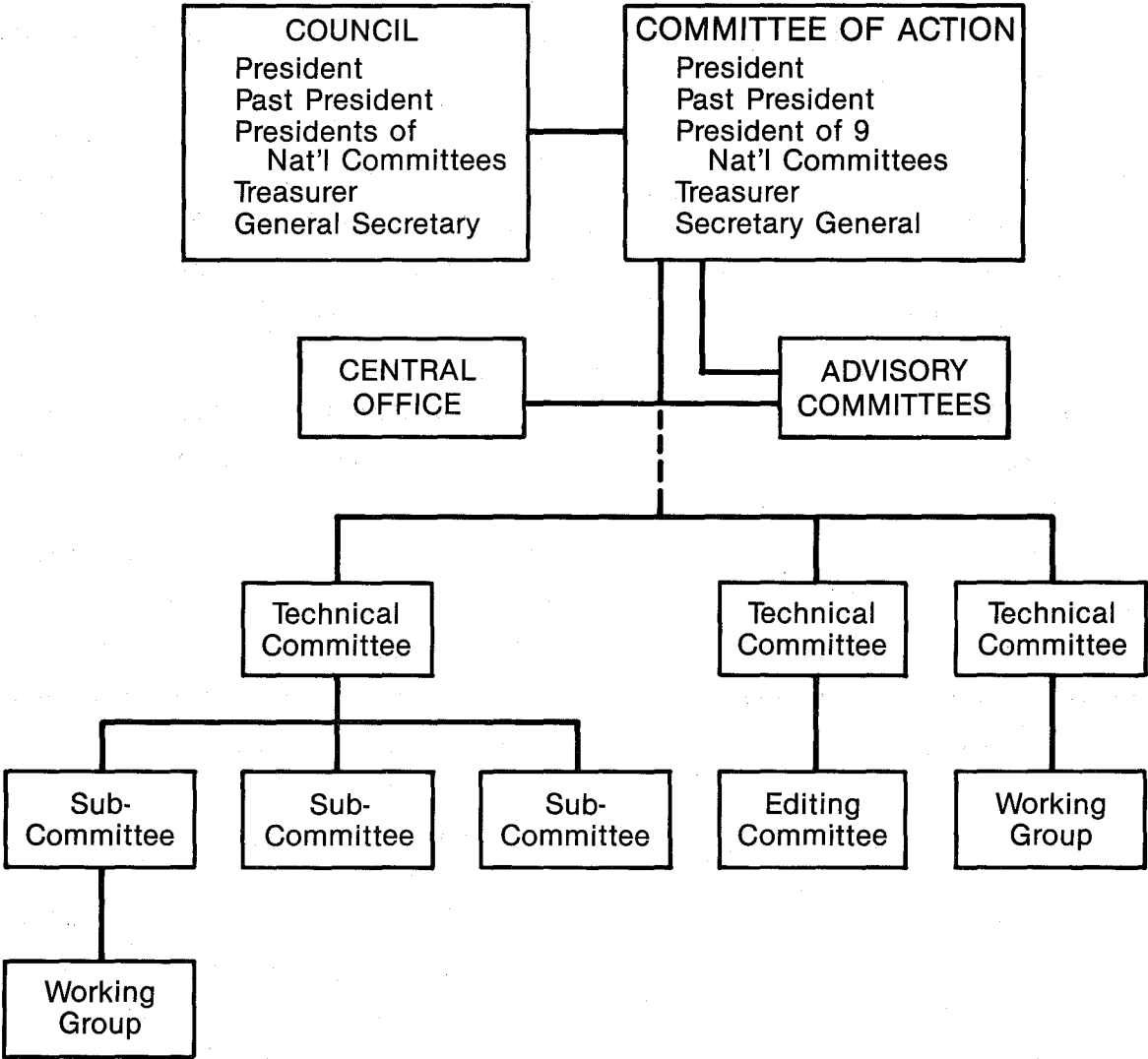
Figure 18. The organization of the International Electrotechnical Commission.

In 1983, TC83 was formed to deal with "Information Technology Equipment." The IEC committees of particular interest to computer/telecommunication issues are listed in Table 7.

7.2.3 Development of IEC Standards

New projects are proposed by members and submitted to the Committee of Action for consideration. After verifying the need and assessing the impact of the new project, the Committee of Action assigns the work to an existing TC (or establishes a new one).

Subsequent work and agreement by the TC results in Draft Proposals or "Six Months' Rule Drafts." (They are listed by that title in ANSI's Standards Action). These drafts are circulated by the Central Office, and National Committees are requested to respond within 6 months. The proposal is adopted as an IEC standard unless 20% (or more) of the membership has cast a negative vote. The approval process can be accelerated.

In certain cases, amendments made to a document approved under the Six Months' Procedure are recirculated under a Two Months' Procedure. If the new draft is not approved, the unmodified Six Months' Rule Draft is printed.

There are nearly 1,700 IEC International Standards and documents published to date. These can be obtained from ANSI. The annual IEC Yearbook incudes a detailed analysis of new and revised standards produced the previous year and reports the progress made by the IEC Committee. Other publications of IEC include an Annual Catalog and the annual IEC Directory.

7.3 The International Telegraph and Telephone Consultative Committee (CCITT)

Because the major thrust of this report is the nature of voluntary standards and their development, the reader might, by now, be questioning the inclusion of the CCITT for at least the following reasons: a) the CCITT has no intrinsic identification with centralized voluntary national groups such as ANSI, but is a treaty organization in which the United States is represented by the Department of State and almost all other countries are represented by the respective governmental postal, telephone, and telegraph administration (PTT); b) the CCITT has not had a traditional interest in the national standards governing national telecommunication networks because its role is chiefly to ensure interoperability of national networks; c) the CCITT does not operate in a TC/secretariat mode, but rather functions with study groups and

Table 7. IEC Technical Committees of Interest to the Telecommunication and Computer Industries (IEC, 1982)

TC. No.	Committee Title	Secretariat
1	Terminology	France
12	Radiocommunications	Netherlands
13	Electrical Measuring Equipment	Hungary
18	Electrical Installations in Ships	Netherlands
29	Electro-Acoustics	Netherlands
39	Electronic Tubes	Netherlands
40	Capacitors and Resistors for Electronic Equipment	Netherlands
44	Electrical Equipment of Industrial Machines	Switzerland
45	Nuclear Instrumentation	Germany
46	Cables, Wires, and Waveguides for Telecommunication Equipment	United States
47	Semiconductor Devices	France
48	Electromechanical Components for Electronic Equipment	Japan
49	Piezoelectric Devices for Frequency Control and Selection	U.S.S.R.
50	Environmental Testing	United Kingdom
51	Magnetic Components and Ferrite Materials	United Kingdom
52	Printed Circuits	Italy
53	Reliability and Maintainability	United States
57	Telecontrol, Teleprotection, and Associated Telecommunications for Electric Power Systems	Germany
60	Recording	Netherlands
65	Industrial-Process Measurement and Control	France
66	Electronic Measuring Equipment	Hungary
74	Safety of Data Processing Equipment and Office Machines	United States
76	Laser Equipment	United States
77	Electromagnetic Compatibility Between Electrical Equipment Including Networks	Germany
83	Information Technology Equipment	Germany
CISPR	International Special Committee on Radio Interference	United Kingdom
ACET	Advisory Committee on Electronics and Telecommunications	Central Office

working parties that develop "Recommendations" rather than standards; and d) the CCITT is a committee of a United Nations treaty organization, the International Telecommunication Union (ITU).

The reasons for the inclusion of the CCITT in this report involve changes both internal and external to the CCITT. The changes all stem from the same worldwide phenomena discussed in Section 6--rapid development of technology requiring interdisciplinary efforts, changes in world trade, and the influence of the developing countries. Because of the interdisciplinary nature of information processing standards in which computers need telecommunications for transmission, and of telecommunication standards in which networks need computers for switching and signalling, the work of the CCITT is critically important to that of ISO and IEC, and vice-versa.

The reader who is interested in obtaining more information about the ITU and CCITT than is offered in the general discussion below is referred to Cerni (1982b), Cerni and Gray (1983), and Codding and Rutkowski (1982).

7.3.1 The CCITT: A Consultative Committee of the ITU

The CCITT is a permanent study committee (since 1956) of the 120-year-old International Telecommunication Union (ITU), that has headquarters in Geneva. The ITU, through the work of its 157 member nations, has responsibility for the regulating, planning, coordinating, and standardizing of international telecommunications of all kinds for every conceivable use.

In contrast to ISO and IEC, whose basic purpose in each case is the development of international standards, the ITU has several purposes and establishes internationally agreed upon radio, telephone, and telegraph Recommendations as only one of numerous methods of fulfilling its goals.

Article 4 of the ITU Convention lists three purposes of the Union:

1. to maintain and extend international cooperation between all Members of the Union for the improvement and rational use of telecommunications of all kinds, as well as to promote and to offer technical assistance to developing countries in the field of telecommunications;

2. to promote the development of technical facilities and their most efficient operation with a view to improving the efficiency of telecommunication services, increasing their usefulness and making them so far as possible, generally available to the public;

3. to harmonize the actions of nations in the attainment of those ends.

To achieve these ends, the ITU:

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1. effects allocation of the radio frequency spectrum and registration of radio frequency assignments in order to avoid harmful interference between radio stations of different countries;

2. coordinates efforts to eliminate harmful interference between radio stations of different countries and to improve the use made of the radio frequency spectrum;

3. fosters international cooperation in the delivery of technical assistance to the developing countries and the creation, development and improvement of telecommunication equipment and networks in developing countries by every means at its disposal, including through its participation in the relevant programmes of the United Nations and the use of its own resources, as appropriate;

4. coordinates efforts with a view of harmonizing the development of telecommunication facilities, notably those using space techniques, with a view to full advantage being taken of their possibilities;

5. fosters collaboration among its Members with a view to the establishment of rates at levels as low as possible consistent with an efficient service and taking into account the necessity for maintaing independent financial administration of telecommunication on a sound basis;

6. promotes the adoption of measures for ensuring the safety of life through the cooperation of telecommunication services;

7. undertakes studies, makes regulations, adopts resolutions, formulates recommendations and opinions, and collects and publishes information concerning telecommunication matters (ITU, 1983).

The CCITT is particularly concerned with fulfillment of No. 7 above in all aspects, except in making regulations.

The structure of the ITU encompasses:

1. the Plenipotentiary Conference (the supreme authority of the ITU);

2. administrative conferences, world and regional (only world administrative conferences may develop or revise Radio or Telephone and Telegraph regulations);

3. the Administrative Council; and

4. four permanent organizations:
    a. the General Secretariat,
    b. the International Frequency Registration Board (IFRB),
    c. the International Radio Consultative Committee (CCIR), and
    d. the International Telegraph and Telephone Consultative Committee (CCITT).

Figure 19 illustrates the organization of the ITU, indicating the structure of authority within the Union.

The CCITT, during the 1981-1984 Study Period, comprises 31 study groups (15 of which are the "technical" study groups considered in this report), a specialized Secretariat of about 40 members, located in Geneva, and its own
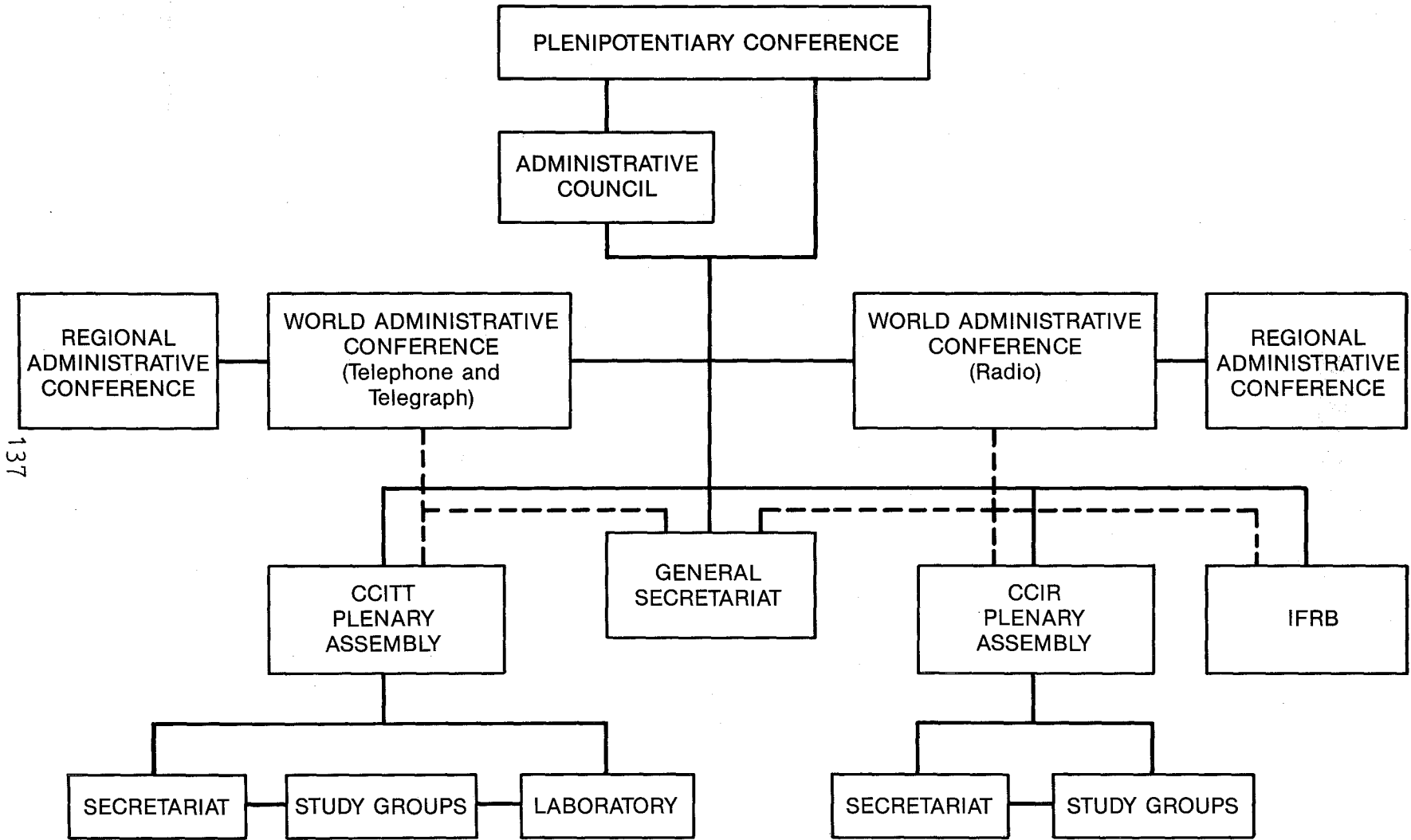
Figure 19. The organization of the International Telecommunication Union (ITU), indicating the structure of authority.

laboratory, also in Geneva, staffed by the secretariat. The laboratory, originally installed in Paris in 1927 with equipment donated by AT&T, was transferred to the ITU headquarters in Geneva in 1947. The CCITT laboratory, now named the Telephonometric Laboratory, carries out "subjective and objective telephonometric 'problems'" in conjunction with the CCITT's Study Group XII, and tests telephone equipment for a fee (Codding and Rutkowski, 1982).

The Radio, Telegraph, and Telephone Regulations, drawn up by member nations at world conferences, are binding on the nations that accept them, since the ITU has international treaty status. A profile of involvement of the United States in the ITU (an involvement marked by extreme contrasts) can be found in Rutkowski (1982).

The Telegraph and Telephone Regulations contain only those general provisions that are of an imperative nature. In addition to these regulations, the ITU offers the more flexible CCITT Recommendations. These Recommendations include technical and operational standards, tariffs, administrative directives, and terminology statements. These Recommendations are not binding on the members but do form a desirable basis for bilateral and multilateral agreements.

CCITT Recommendations include such diversity as the highly technical and detailed 90-page Recommendation X.25 (approved 1976, amended 1980 and 1984) that covers packet-switched networks, and the one-page Administrative Recommendation G.705 (1980) that concerns conceptual principles for the study of the ISDN within the CCITT. Certain of these Recommendations, the technical Recommendations, generally become world standards by providing guidance on the operational methods and techniques to use in the international telecommunication network, assuring a coherent whole of standard quality.

Membership in the CCITT is extended in full to the Administrations of the 157 member nations of the ITU, each of which has one vote at official meetings, regardless of the number of attendees. Participation is extended also, in varying degrees, to recognized private telecommunication operating agencies (RPOA's), scientific or industrial organizations (SIO's) approved by their respective governments, and at present, 32 international groups including ISO and IEC. The FCC has recently initiated inquiry on the possibility of conferring the "RPOA" status on non-common carrier entities. Implied in the notice of inquiry (Docket 83-1230) was the recognition that "foreign administrations currently deal only with the FCC-authorized common

carriers in the U.S, and that international agreements contain no provisions specifically recognizing unregulated (enhanced) service providers" (Telecommunications Reports, 1983d).

Currently, 57 U.S. organizations, plus the U.S. Government, are dues-paying official members of the CCITT. These include 19 RPOA's (38 percent of CCITT total of 50) and 38 industrial or scientific organizations (28 percent of CCITT total of 137). Each CCITT member from the United States must have acceptance and sponsorship by the U.S. Department of State.

7.3.2 Technical Work and Recommendation Development

The bulk of the CCITT Recommendation work takes place in the CCITT technical study groups, each of which deals with a specific aspect of telecommunications. Table 8 lists the 15 technical study groups (SG) of the 1981-1984 Study Period. (Appendix D (CCITT, 1984a), lists those for the upcoming 1985-1988 Study Period as approved at the VIIIth Plenary Assembly in October 1984.) Each SG is subdivided into working parties (WP). Although the CCITT has 16 other working groups, (in addition to the technical groups in Table 8) that deal with additional activities such as the needs of developing countries, the economics of telecommunications and regional planning of networks, the stress in these pages is on those studies that directly shape the structure of public telecommunication networks and services by Recommendation development.

In theory, Recommendation development starts with the plenary assembly which meets every four years. This body approves a list of technical subjects, or "Questions" as they are called, the study of which would lead to improvements in international telecommunications. In practice, the Questions are the overflow of the work begun in the previous study period, with new items added each study period. The nature of the questions helps to determine the number of study groups and the individual SG structure, which varies somewhat from assembly to assembly. The questions, entrusted to the appropriate SG, are studied in the interval before the next plenary assembly. This interval is called a study period. The study is carried on largely through contributions that are submitted by interested group members, distributed by the CCITT Secretariat in Geneva, and discussed either by correspondence or at scheduled international meetings.

The study of a Question is judged complete when the pertinent SG has found a satisfactory solution, in the form of a Recommendation or amendment.

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Table 8. CCITT Technical Study Groups of the 1981-1984 Study Period

No.	Title
I	Definition and Operational Aspects of Telegraph and Telematic* Services (Facsimile, Teletex, Videotex, etc.)
II	Telephone Operation and Quality of Service
III	General Tariff Principles
IV	Transmission Maintenance of International Lines, Circuits, and Chains of Circuits; Maintenance of Automatic and Semi-automatic Networks
V	Protection Against Dangers and Disturbances of Electromagnetic Origin
VI	Protection and Specification of Cable Sheaths and Poles
VII	Data Communication Networks
VIII	Terminal Equipment for Telematic* Services (Facsimile, Teletex, Videotex, etc.)
IX	Telegraph Networks and Terminal Equipment
XI	Telephone Switching and Signalling
XII	Telephone Transmission Performance and Local Telephone Networks
XV	Transmission Systems
XVI	Telephone Circuits
XVII	Data Communication over the Telephone Network
XVIII	Digital Networks

*"Telematic" was used provisionally by the CCITT during the 1981-1984 Study Period.

This work is often the result of much intergroup consultation and is increasingly the product of collaboration with other international organizations as well. The plenary assembly, alone, is empowered to accept or reject the Recommendations and/or amendments presented by the study groups. In almost all cases, however, the plenary assembly approves the Recommendations as presented or else requires only minor changes. Under certain conditions of urgency, and with the unanimous agreement of the members in attendance at the study group meeting making the request, a Recommendation may be accepted provisionally (through a ballot procedure) by the CCITT during the course of a study period. This so-called Provisional Recommendation is then subject to final approval by the upcoming assembly.

The work of the CCITT has grown significantly in the past decade (see Figure 14, Section 6). In 1972, the Vth Plenary Assembly approved 67 new Recommendations; in 1980, the VIIth Plenary Assembly approved 204 new Recommendations and 87 substantially amended Recommendations. All indications at this time point to continued increase in the volume of CCITT work.

The proceedings of each plenary assembly, as well as the total set of Recommendations, are published in a "CCITT Book" that is color coded and multi-volumed. The CCITT Yellow Books (published in 1981) consist of ten volumes and 30 separate fascicles (books). The 1981-1984 books, to be published in 1985, will be the "CCITT Red Books." The CCITT Yellow Books, separately or as a set, may be purchased directly from the ITU, Geneva, or from the National Technical Information Service (NTIS) in Springfield, VA. Ongoing information on the CCITT activities can be found in the monthly ITU publication, Telecommunication Journal.

7.3.3 The U.S. Organization for the CCITT

The participation of the United States in the work of the CCITT is channeled through the United States Organization for the CCITT (commonly referred to as the "U.S. CCITT"). This national organization, headed by the Office of International Communications of the U.S. Department of State, exists primarily to assist and advise the Department of State on matters concerning U.S. participation in CCITT affairs. Membership in a U.S. CCITT study group is open to interested parties and does not require membership in the CCITT.

The U.S. CCITT Charter of 1977 (U.S. CCITT, 1977), in delineating the purposes of the organization, states that the U.S. CCITT will:

1. promote the best interests of the United States in CCITT activities;

2. provide advice on matters of policy and positions in preparation for CCITT plenary assemblies and meetings of the international CCITT study groups;

3. provide advice on the disposition of proposed contributions to the international CCITT; and

4. assist in the resolution of administrative/procedural problems pertaining to the United States CCITT activities.

Figure 20 illustrates the structure of the U.S. CCITT. The National Committee constitutes a steering body and has purview over the agenda and work of the four study groups and of the ISDN Joint Working Party. Each of the four study groups, A to D, covers the work of several relevant international CCITT study groups: Study Group A (I and III); Study Group B (VIII and IX); Study Group C (II, IV, V, XI, XII, XV, XVI, XVIII); and Study Group D (VII, XVII). The ISDN Joint Working Party, established by the National Committee in May 1981, contains members of all four study groups (although it is not limited to these members) in recognition of the expected impact of the ISDN on existing telegraph, telephone, and data services. This ISDN Joint Working Party is concerned mainly with the contributions from the United States pertaining to the ISDN, particularly those submitted to SG XVIII.

The contributions from the United States to the CCITT are not sent directly to Geneva from a member organization. Rather, the contribution is first passed through a formal chain of approval and/or coordination (see Figures 21 and 22). The resultant approved contribution, depending on its source, may be either a "U.S. contribution," or an "individual member contribution." The U.S. contribution represents the position of the United States as approved by one of the U.S. study groups. The original contribution may come from any U.S. group or individual; membership in the international CCITT is not required. The individual member contribution represents the position of one of the private U.S. organizations that is a member of the CCITT.

Participation in a U.S. CCITT study group meeting is open to all interested persons. Further, any interested individual, standards committee (e.g., X3S3), or organization (e.g., ANSI) may present a document to the study group as a suggested contribution to the CCITT. Neither CCITT membership nor previous study-group participation is required. If this document is approved by the study group, it would be sent to Geneva as an official CCITT contribution from the United States.

ORGANIZATION OF U.S. CCITT
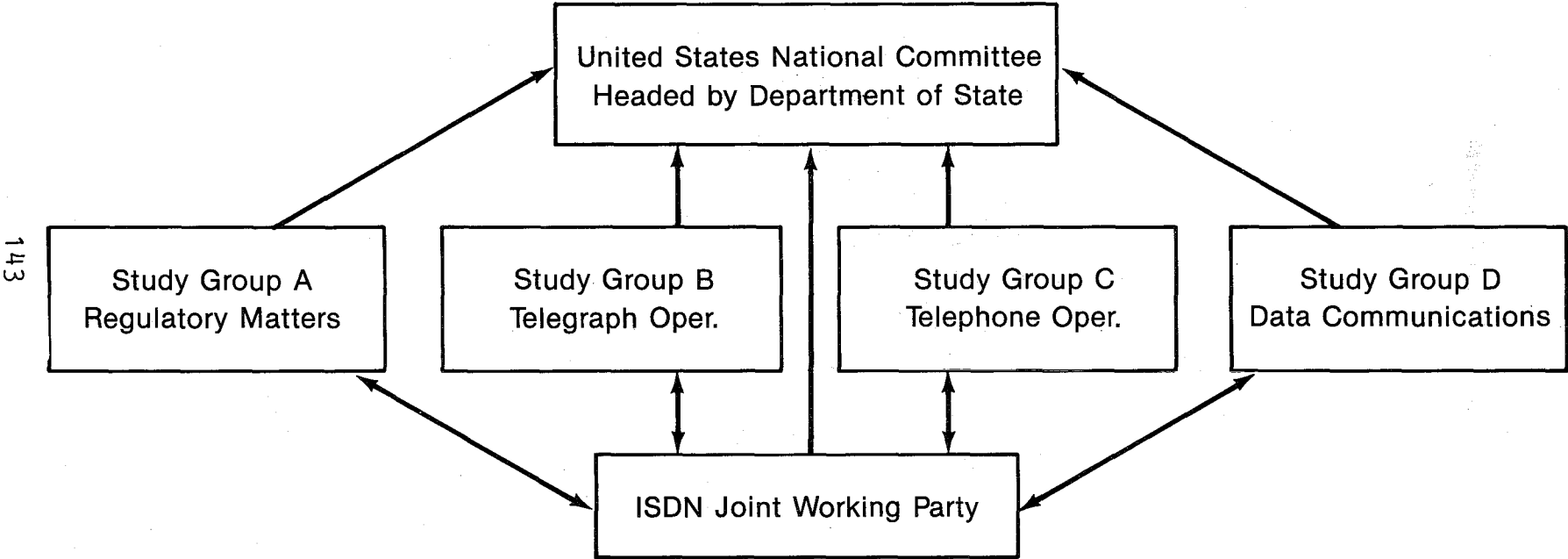
Figure 20. The structure of the U.S. Organization for the CCITT.

INDIVIDUAL MEMBER CONTRIBUTION
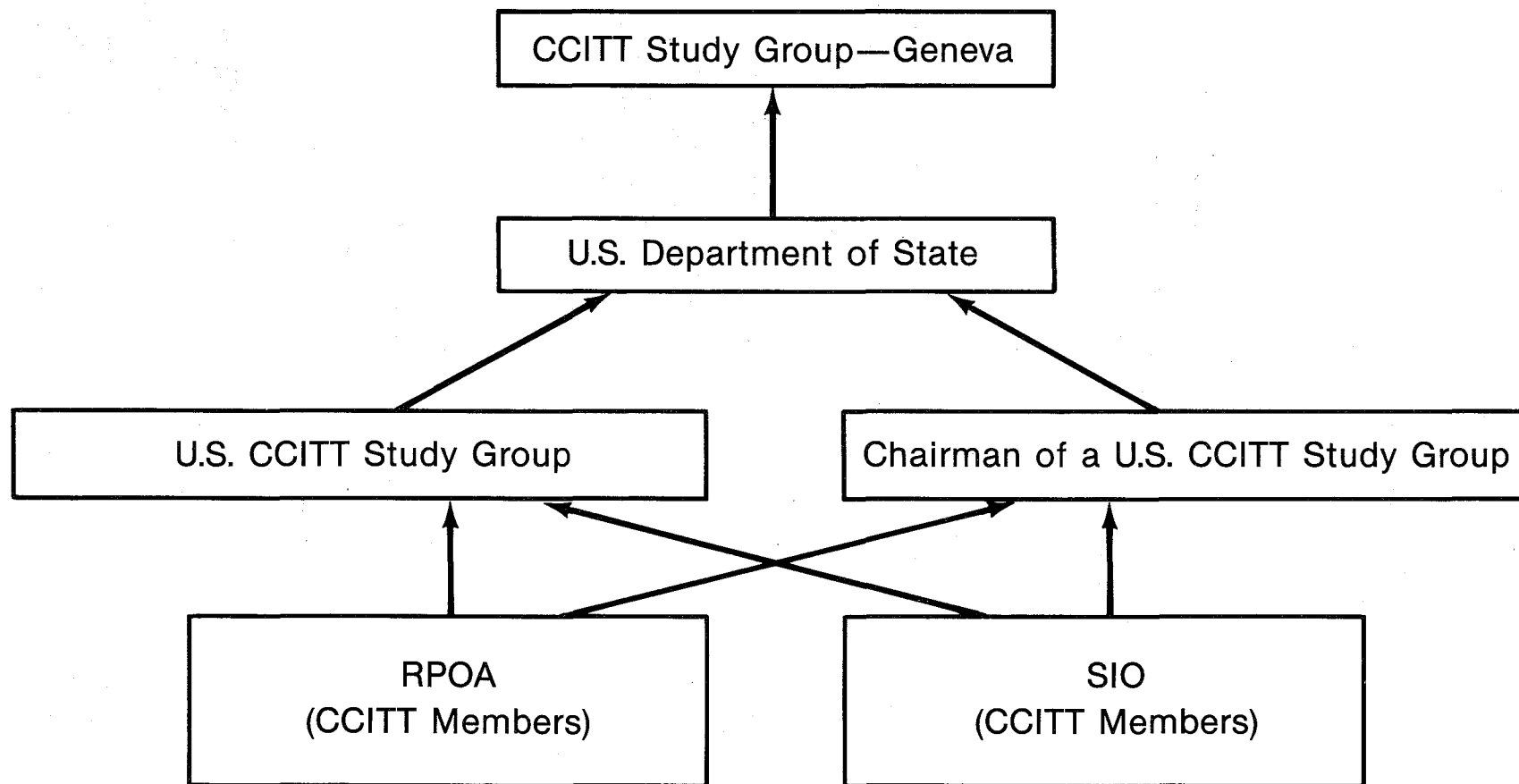
Figure 21. The formal "chain of approval" for the "Individual Member" contributions that are presented to the CCITT from the United States.

U.S. CONTRIBUTIONS

```
                    ┌─────────────────────┐
                    │    CCITT Study      │
                    │   Group-Geneva      │
                    └─────────────────────┘
                               ▲
                               │
                    ┌─────────────────────┐
                    │ U.S. Department of State │
                    └─────────────────────┘
                               ▲
                               │
                    ┌─────────────────────┐
                    │ U.S. CCITT Study Group │
                    └─────────────────────┘
```

```
┌──────────────────┐                      ┌──────────────────┐
│     Ad Hoc       │                      │ Other National   │
│   Committee      │                      │  Organizations   │
│ (Participants    │                      │(e.g. ASC Technical│
│  appointed by    │                      │ Committee, EIA)  │
│  Study Group)    │                      │                  │
└──────────────────┘                      └──────────────────┘
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┌──────────────────┐                      ┌──────────────────┐
│  RPOA or SIO     │                      │ Other Company (not│
│ (CCITT member)   │                      │ CCITT member) OR │
│                  │                      │ Government Agency │
└──────────────────┘                      └──────────────────┘
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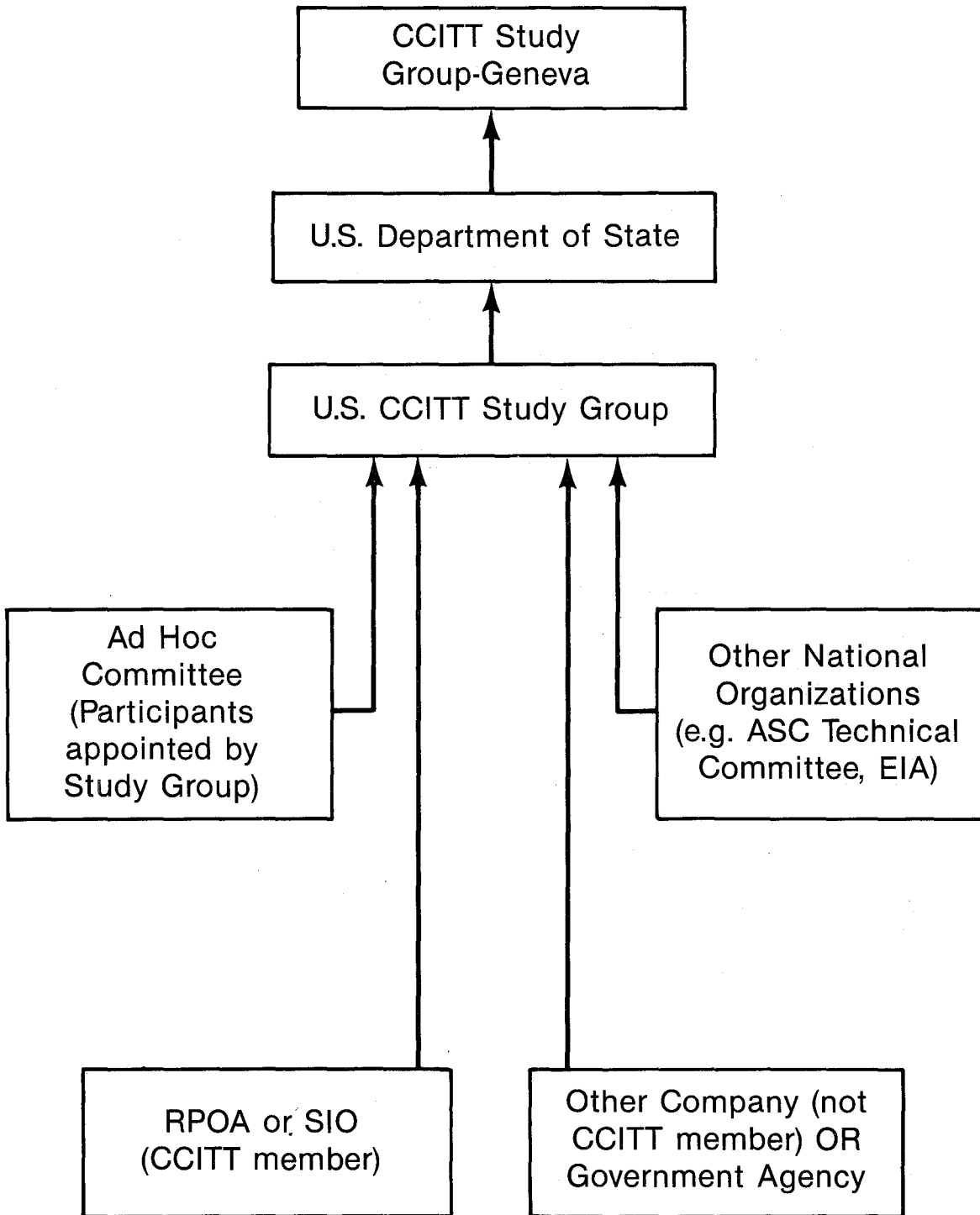
Figure 22.   The formal "chain of approval" for the "U.S."
             contributions that are presented to the CCITT
             from the United States.

In the particular case of ANSI-accredited standards committees, the contribution presented to the national CCITT study group has been from the technical committee level (e.g., X3S3, X3T5), at least.

The purpose of the chain of approval or system of coordination, depicted in Figures 21 and 22, is to avoid the embarrassment that would ensue if two U.S. organizations were to input contradictory positions to the CCITT. This could be detrimental to the United States as a whole. The U.S. CCITT National Committee is not actually involved in these contribution proceedings as they transpire in the national SGs, but is concerned with matters of organization, responsibility, and (generally non-technical) issues of very wide interest.

Official contributions from the United States cover all topics, generally, and are relatively numerous in the related areas of digital networks and the ISDN, telephone operations and maintenance, telephone switching and signaling, data networks, and the transmission of data over the telephone network. Fifteen percent of the CCITT contributions (excluding those from international organizations, study groups, etc.) distributed by Geneva worldwide during 1981 were from the United States (61 out of 406).

The U.S. CCITT serves also as the pool of informed public and private sector personnel that can be drawn upon to staff U.S. delegations to the international study group meetings and plenary assemblies. One person, appointed as head of the delegation, is responsible for managing the work of the delegation and advancing the previously approved United States' position in the manner judged to be most effective.

7.4   The Future of the International Standards Organizations

The international standards organizations all share the escalating problems referred to throughout this report. These problems include: the accelerating costs coupled with limited (and in some cases diminishing) resources; the need to speed up the standardization process to keep pace with technology development; the rapid approach of the "Information Age"; the maintenance of the escalating number of standards; the preponderance of developing countries as organizational members and the appropriate response to their needs that will not interfere with the needs of the industrialized nations; the changing nature of the standards and of the standardization process; and the lack of powerful user support born of informed public opinion. The pressures currently exerted on the organizational structures of

the ISO, the IEC, and the CCITT (and ITU) by these problems cannot be underestimated.

All three organizations are deeply involved in solving the above issues. None can afford dispersal, duplication of effort, or jurisdictional disputes. The solutions call for innovative change based on creative, future-oriented thinking. The proposed and actual cooperative ventures among these organizations are on the increase in an attempt to reduce the work overlap and increase efficiency. Each organization has formal statements of mutual support and cooperation. However, these attempts have also revealed the extreme difficulty of changing processes intrinsic to each organization. An example of the efforts in this direction concerns an informal meeting of ISO and IEC representatives in which agreement was reached that the following actions should be implemented:

1. An ISO/IEC mechanism should be established at the working level to coordinate procedures and effectively allocate and process technical work.

2. An executive-level ISO/IEC mechanism should be established to coordinate policy and long-range plans for the two organizations.

3. The presidents of IEC and ISO should immediately address and manage the contracts of the general secretary of IEC and the secretary general of ISO to bring both organizations under a single general secretary or secretary general at the earliest possible date (ANSI Reporter, 1983d).

In late 1984, the establishment of a joint ISO/IEC Technical Programming Committee was announced. This committee's mission is to take rapid action when either organization recognizes the need for joint planning. It is also responsible for preventing overlaps in the technical work and eliminating such overlaps if they are recognized to exist (ANSI Reporter, 1984b).

Collaboration between ISO/IEC and CCITT was formally addressed at the VIIIth Plenary Assembly. In ISO Council resolution 36/1984, sent to the CCITT in Ocotber 1984, the ISO Council recognized "the common interest of ISO/IEC and CCITT in the develoment of information technology standards, which take full account of the needs of manufacturers, users, and those responsible for communication systems" (CCITT, 1984b). The ISO resoltuion resolves that:

1. ISO/IEC will continue to cooperate and collaborate in coordinating its work programme in the field of information technology with those of other international bodies, and in particular with the CCITT;

2. ISO/IEC will seek to establish with CCITT a select study team to review their respective programmes of work relating to

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information technology standards and to recommend a coordinated programme, which, after authorization by the establishing bodies, may include joint activity of work in this field;

3. ISO/IEC, anticipating a positive response from CCITT, requests that such a select study team reports from time to time (e.g., at six month intervals) to both bodies with practical recommendations on how to best achieve the above aims (CCITT, 1984b).

Appendix E of this report contains several representative documents dealing with the ISO/IEC/CCITT collaborative efforts. The first is CCITT Recommendation A.21, "Collaboration with othe International Organizations on CCITT-defined Telematic Services" (CCITT, 1981).

The second, Appendix E.2, is an IEC contribution to the VIIIth Plenary Assemby of the CCITT, "Cooperation between the CCITT and the IEC" (CCITT, 1984c). The introduction states:

The growing complexity of systems, coupled with fast developments of technology require agreement on standards more rapidly than in the past. This need for acceleration is accompanied by a general scarcity of qualified manpower. The IEC suggests that by strengthening the long standing co-operation between the CCITT and IEC by means of a joint review of the respective technical programmes the necessary international standards can be developed more effectively (CCITT, 1984c).

The third Appendix E document, E.3, is a contribution from ISO to the Plenary Assembly, "Statement on CCITT/ISO liaison activity" (CCITT, 1984d). This document, in which the ISO wishes to "confirm the successes and benefits of working together" during the 1981-1984 Study Period, urges "the continuance and improvements of this liaison activity." This document is of particular interest to this report because it is a concise summary of TC97's working relationships with the CCITT.

Appendix E.4 is CCITT's response to the ISO Council resolution 36/1984 mentioned above. "Draft Resolution on Collaboration with ISO and IEC" (CCITT, 1984e) will be published in the CCITT Red Book.

The shape of the international standards world of 1990 will inevitably be different from that of today. One purpose of this report is to encourage active U.S. participation in the decisions being made at this moment that will affect not only the shape of the organizations, but the shape of the future as well.

7.5 ANSI's Role in International Standardization

Section 5 expanded on ANSI's role in the U.S. voluntary standards system, particularly as it relates to American National Standards. Section 7.5 describes ANSI's role as manager and coordinator of U.S. participation in the work of nongovernmental international standards bodies, such as ISO and IEC. Through ANSI, U.S. interests are provided with the opportunity to participate effectively in international standards activities.

For the purpose of improving U.S. representation at international meetings, ANSI has recently completed a new document, "ANSI Criteria for the Development and Coordination of U.S. Positions in International Standardization Activities of the ISO and IEC." Further information is available from ANSI.

7.5.1 ANSI and International Organizations

Although ANSI coordinates U.S. participation in ISO and IEC, the extent of this participation is ultimately determined, not by ANSI, but by those U.S. interests that provide the financial and technical support. At present, ANSI, as the "most productive of ISO's decentralized organizations" (Peyton, 1982), holds the secretariat of almost 15% of ISO's technical committees and subgroups, and is active in most other technical committees. (For comparison, Europe holds about 75% of the secretariats.) In most cases, it is a U.S. organization or Government agency that holds the secretariat through ANSI. An example of this is CBEMA, Secretariat of ASC X3. In other cases, ANSI itself holds the secretariat. The United States holds observer membership in the technical committees in which it does not participate actively.

The USNC of IEC, directed by ANSI, participates in 90% of IEC's technical work. The United States holds the secretariats of about 16% of IEC's committees.

ANSI is involved in the administration of both ISO and IEC. ANSI has membership on the ISO Council and on the Executive and Planning Committees (EXCO and PLACO). The USNC of IEC participates in the Commission's entire technical program and is represented on the Commission's governing bodies.

The method developed by ANSI to provide for effective, coordinated U.S. participation in international standardization is the establishment of technical advisory groups. A technical advisory group (TAG) is formed whenever interest has been demonstrated in a particular ISO activity and adequate financial and technical support has been committed to ensure

effective participation. The TAG administration is assigned, for example, to a trade association, technical or professional society, or Government association.

The membership of the TAG itself often comes from the corresponding U.S. standardization committee to ensure close coordination between U.S. national and international standards activities. Some examples of TAGs are: X3S3 is the TAG for ISO TC97 SC6; NBS is the TAG for ISO TC97 SC14; USNC is the TAG for IEC TC74; and X3 is the TAG for ISO TC97. The requests for TAG members for either ISO or IEC are posted by ANSI in Standards Action. Table 9 lists the TC97 subcommittees and their TAGs.

The TAG assumes responsibility for assisting the TC or SC secretariat in preparing the technical content of the Draft Proposals and Draft International Standards. The TAG's responsibilities are all focused on the ISO (or IEC) committee meetings. If the TAG decides to present a DP to an ISO committee the DP must be based on an existing standard, ordinarily an ANS or an industry standard. An ANS is preferred because normally "American National Standards receive a greater degree of support internationally than those having limited national acceptance" (ANSI, 1981b). All Draft Proposals are submitted by mail to ISO and the ANSI staff participates in this effort.

Shortly before an international meeting, the TAG will meet to establish the ANSI (i.e., U.S.) position on agenda items. This position must be clearly understood by the head of the U.S. delegation to the meeting, since this person is ANSI's principal spokesman.

A draft of Model Operating Procedures for U.S. Technical Advising Groups to ANSI for ISO activities have been developed by ANSI (Standards Action, 1984). Upon approval of these model procedures, "it is expected that new and existing technical Advisory Groups will consider adopting the model . . .". Such adoption will ensure that the TAG procedures comply with the "ANSI Criteria for the Development and Coordination of U.S. Positions in International Standardization Activities of the ISO and IEC" mentioned above.

Several American National Standards have become the basis for ISO standards. (Many ISO Information Processing Standards, for example, are based on U.S. standards.) The opposite has not been true in the past. However, in keeping with the trends discussed in Section 6, the adoption of international standards as national standards has become more common in Europe in recent years, and as early as 1981 it was "ANSI's long-range hope that an increasing number will be suitable for adoption here in the future" (ANSI, 1981b).

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Table 9 The U.S. TAGS for TC97 Subcommittees
as of June 1984

Committee	Title	U.S. TAG
TC97	Information Processing Systems	X3
SC1	Vocabulary	X3K5
SC2	Character Sets and Coding	X3L2
SC5	Programming Languages	X3PLS
SC6	Data Communications	X3S3
SC7	Documentation of Computer-based Systems	X3K1
SC10	Magnetic Disks	X3B7
SC11	Flexible Magnetic Media for Digital Data Interchange	X3B1
SC12	Instrumentation in Magnetic Tape	X3B6
SC13	Interconnection of Equipment	X3T9
SC14	Representation of Data Elements	NBS
SC15	Labeling and File Structures	X3L5
SC16	Open Systems Interconnection	X3T5
SC17	Identification and Credit Cards	X3B10
SC18	Text Preparation and Interchange	X3V1
SC19	Office Equipment and Supplies	X3OES
SC20	Data Encryption	X3T1

During 1983, CCITT Recommendation X.25 was adopted as ANS X3.100, and there are several ISO standards presently being considered.

7.5.2 ANSI and Regional Standards Organizations

Close ties are maintained by ANSI with some regional standardization organizations. These include the Pacific Area Standards Congress (PASC) and the European Committee for Standardization (CEN).

As a creator and active participant in PASC, ANSI was host to its first meeting in Honolulu in 1973. Members of PASC are the national standards bodies of 17 Pacific-rim nations, including the United States. Although PASC is not a standards developing organization, its major objective is to strengthen the standardization programs of ISO and IEC, and to improve the ability of the countries on the Pacific Rim to participate in these organizations. PASC has been active in asking for "an intense study of cooperation between ISO and IEC to determine if two organizations are really necessary" (ANSI Reporter, 1983e).

The activities of CEN are directed toward eliminating barriers to European trade by establishing European standards as individual national standards. The standards may then serve as unifying and coordinating documents to which reference can be made in European Economic Community

directives. In 1981, ANSI and CEN reached an agreement that permits Standards Action to list the draft European standards developed by CEN, thereby providing U.S. interests with an opportunity to comment. In turn, ANSI provides CEN with information on proposed American National Standards. This, of course, is also in keeping with the spirit of GATT directives.

7.5.3 The Cost to ANSI

At present, more than 25% of ANSI's total budget is spent on international standardization activity (see Figure 9, Section 5.1), about equally distributed between ANSI administration activities and ISO/IEC dues.

According to present estimates, a steady 10% per year growth in ISO dues and a 13% growth in IEC dues will double the 1983 figure by 1986. Total 1984 ANSI international dues are expected to reach $835,000 (ANSI Reporter, 1983f). The projected increases in the ISO/IEC dues represent a "grave challenge to ANSI and all major national standards organizations" (Peyton, 1982). According to Peyton, the sheer magnitude of these figures requires "a vigorous evaluation of international standards programs and should motivate consolidation of ISO and IEC services."

A key deterrent to greater U.S. participation in international standardization is the cost. The dues paid by ANSI to ISO and IEC are only the beginning. The financial burden carried by the companies and organizations who choose to send the participants to standards meetings is escalating daily. For CCITT participation, the burden is even compounded since the dues are borne by the individual member-companies (as well as the Government). The key consideration is the perceived tradeoff between possibly few "present" but potentially many "future" benefits. Company willingness to pay the price for international participation will, in the long run, make or break future U.S. involvement.

In 1982, ANSI surveyed the general interest of its members in international standardization. Based on 400 responses, out of a possible 1,138, the results indicated that international standards are widely used in the United States although they were given only "medium priority" by respondents (Travaglini Associates, 1983).

The interest that was shown in international standards was generally related to export businesses, either alone or in conjunction with manufacturing operations abroad. However, import business and other

cooperations were also cited as motivating factors, along with a desire to promote the harmonization of international standards with U.S. standards.

Respondents with little interest in international standards advocated that ANSI spend less on international and more on national activities. One comment asserted that "ANSI expenditures on international standards are disproportionately high when the total benefits of national and international standards are considered. However, ANSI provides an essential service representing the United States in international standards. If funding is not available elsewhere, it must come from the Institute" (Travaglini Associates, 1983).

The dilemma remains, and the responsibility rests mainly on those companies, organizations, and even entire industries who participate in international standardization. ANSI responds to the needs as expressed by its members. At present, several industrial studies are already completed or are underway in the United States with regard to the individual industry's international standards requirements and priorities. One study by CBEMA is a proposed plan for cooperative standards development and joint ISO/IEC services.

7.5.4   ANSI's Interest in International Information Processing-Related Standards.

As the Secretariat for ISO TC97, ANSI is responsible for managing the fast-paced standards work in ISO that now includes certain ISDN studies as well as those on the OSI and other information processing standards. ANSI is secretariat, also, for 8 of the 20 TC97 subcommittees, including SC6, "Data Communications," and SC16, "Open Systems Interconnection." ANSI's considerable investment of time, money, and personnel in TC97 over the past two decades is the best measure of the importance that ANSI (and the U.S. computer industry) places on this work.

The rapid development of international TC97 activity has resulted in the recent (1983) expansion of the ANSI Information Systems Standards Board (ISSB) to include two new committees--one national, one international. These committees assist the ISSB in establishing closer coordination of the national/international development of standards, and "will help avoid duplication of efforts and waste of limited manpower and other limited resources" (ANSI Reporter, 1983g).

The formation of the new ISO TC184 on Industrial Automation Systems is an international response to accelerating technological developments. ANSI has created the Industrial Automation Planning Panel (IAPP) to serve as an umbrella organization to coordinate national standardization and U.S. participation in parallel international work. The panel has created three working groups to identify existing standards and areas in need of further standardization in this field, and to develop an organizational matrix for assignment of this work in the United States. The scopes of the three working groups are: Safety, Health, and Ergonomics; Hardware and Equipment Control; and Systems Control.

7.5.5 The Relationship of X3 to TC97

The organizational structures of the technical groups of X3 and TC97 are closely aligned. X3 is the ANSI-appointed TAG for TC97, and the X3 technical committees and subgroups are TAG's for 15 of the 16 TC97 subcommittees (refer to Table 9).

To deal with the extensive involvement of X3 in TC97, each technical committee of the X3 organization has an X3-appointed International Representative (IR). The IR acts as liaison, maintaining the flow of information and communication between the individual technical committee of X3 and the X3 parent committee, ISO, and the non-U.S. counterparts on related technical matters (e.g., ECMA).

The IR has five major responsibilities:

1. to act as a technical advisor to X3;

2. to maintain (international) document flow between the TC and X3 Secretariat (CBEMA), and between ISO (through CBEMA) and the TC;

3. to ensure the timeliness of both U.S. technical contributions and ISO requested U.S. comments and votes;

4. to act as chief delegate (or advisor to the delegation) to TC 97/SC meetings; and

5. to keep the X3 technical committee informed on relevant international work and on its responsibilities to TC97.

As the work of X3, in general, becomes more internationally oriented, the role of the IR is becoming crucially important. The role requires astute familiarity with international protocol, and this familiarity is hard to come by. This aspect of international standardization--including negotiation techniques and the role of informal discussions--can be learned only through experience. The IR must clearly understand the U.S. positions, fall-back

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positions, and the possible opposing arguments. The need for continuous involvement by an individual in standards work is one of the points dealt with in Section 10.

8. THE ISDN AND WORLDWIDE STANDARDIZATION EFFORTS

The present worldwide efforts to provide voice and data services over a common set of digital network facilities have become embodied in the acronym-turned-descriptor, "ISDN." Philosophies and concepts differ widely. Some write about "working toward the ISDN" (in a global sense), while others talk about "developing an ISDN" (in either a national or multi-ISDN sense). The ISDN is really a generic concept, and the concept eludes absolute definition. The ISDN is defined only in relation to agreed-upon standards. The major importance of the accelerating ISDN-related efforts is the implication of universal agreement that the techniques already exist for the economic conversion of all types of signals to digital form.

This report does not analyze the escalation of ISDN-related issues, either in the United States or in the rest of the industrialized world--especially in Europe and Japan. The FCC Notice of Inquiry on the ISDN (see Section 4.2.2 and Appendix B) summarizes the meaning of the ISDN and its possible significance in the competitive U.S. environment. The purpose of this section is to illustrate the planned interdisciplinary system of standards, discussed in Section 6.1.2, by compiling the various ISDN standardization efforts being made nationally and internationally. An up-to-date summary of ISDN issues can be found in the special issue of the IEEE Communications Magazine (1984), dedicated to ISDN topics.

8.1 The CCITT and the Development of ISDN Studies

To place these efforts into historical and social perspectives, the role of the CCITT in the initiation of these studies is presented. The discussion makes it clear that the concept was a logical outcome of technology development as two formerly separate fields began to merge. It is not the product of one individual, one company, one organization, or one nation. Rather, the ISDN concept evolved naturally in the international arena of the CCITT from studies on digital networks.

8.1.1 The Beginnings: 1968-1980

The roots of the studies and standardization efforts now generically termed ISDN are firmly planted in the CCITT. In 1968, the IVth CCITT Plenary Assembly (Mar del Plata) established the Study Group XVIII (SG XVIII) forerunner, Special Study Group D. The purpose of Study Group D was to study the "Questions" (see Section 7.3) relating to pulse code modulation (PCM) and the planning of digital systems. Study Group D was given full study group status 8 years later by the VIth Plenary Assembly in Geneva, 1976.

Table 10 gives the titles of the first question assigned to this group by the four CCITT plenary assemblies from 1968-1980. The title change from assembly to assembly tells the evolution of the ISDN concept in the CCITT. In summary, digital systems led to "integrated digital networks;" integration of services led to "integrated services digital network." The former refers to the integration of equipment, providing a digital pathway for one service (e.g. telephony). The latter refers to the use of the integrated digital network for its specific service and for other services as well (e.g., telephony, data, facsimile, telex).

Therefore, the ISDN concept began in network studies and evolved into the combination of network and services. The overall concern of SG XVIII is still the digital network.

From minor beginnings in 1968, the ISDN work has escalated into one of major concern to the CCITT. In 1980, the VIIth Plenary Assembly (Geneva) assigned SG XVIII the responsibility of coordinating the ISDN-related studies in 9 of the 14 other CCITT Study Groups. In 1980, for the first time, the CCITT declared one topic (the ISDN) as the major concern of the then upcoming study period (i.e., 1981-1984). It is expected that the set of CCITT ISDN Recommendations will be sufficiently established by the late 80's to make digital subscriber services possible in the early 90's.

8.1.2 The Meaning of CCITT-Standardized Services

Because the ISDN involves integrated services as well as integrated networks, it is appropriate to examine the very specific meaning the word "service" has traditionally had in the CCITT. A broader use of this word is now also common (e.g., in the OSI Reference Model), and the difference is a potential source of confusion.

Traditionally, for the CCITT, a standardized (international) service is characterized by:

Table 10. Question 1 as Assigned to Special Study Group D (1968-1976)
and to Study Group XVIII (1976-1984) (Cerni, 1982b)

Study Period	Title of Question 1
1968-1972	Planning of digital systems
1972-1976	Planning of digital systems and integration of services
1976-1980	Overall aspects of integrated digital networks and integration of services
1980-1984	General network aspects of an integrated services digital network (ISDN)

1. complete, guaranteed end-to-end compatibility;
2. CCITT standardized terminals, including procedures;
3. listing of the service subscribers in an international directory;
4. CCITT standardized testing and maintenance procedures; and
5. charging and accounting rules.

There are three fully standardized CCITT services: telegraphy, telephony, and data. There are four "new" CCITT telematic services in process of standardization: teletex, facsimile, videotex, and message handling. (For a more complete discussion on CCITT services see Cerni, 1982b and Burtz and Hummel, 1984.) The goal of the CCITT in developing Recommendations for telecommunication services has not changed with the emphasis on the ISDN. This goal is to ensure high quality international telecommunications for the end user, regardless of the make of the terminal equipment and the type of network used nationally to support the service.

This does not imply that merely standardizing the physical connection from network interface to network interface is sufficient to establish an internationally standardized service. The telex service (a telegraphy service) is a good example of the detailed technical and procedural specifications required to ensure end-to-end compatability in international telecommunications. The specifications for telex include the coding and character set, the significance of certain sequences of characters, the format of the printout, and even rules for the interference of incoming calls with local operation. This extensive standardization permitted the telex service to become "the one and only global text communication service which allows easy exchange of printed messages throughout the world without any problem of incompatibility" (Hummel and Staudinger, 1983).

This process of standardization, in effect a system of standards, is always carefully designed in CCITT to permit sufficient freedom for innovation on both the terminal and network sides. It is this process that is being repeated today in a more sophisticated technological milieu for the telematic services, and in a multi-service context in ISDN and OSI.

Section 9.3 extends this discussion of the CCITT-standardized services by indicating the partitioning of the service-related functions into layers corresponding to the OSI Reference Model. In brief, from a CCITT perspective the OSI Reference Model permits:

> . . . the identification for a given service of the functions standardized by the CCITT and, for a non-CCITT system, of the functions to be standardized by the manufacturer of the particular telematic or data system (Hummel and Staudinger, 1983).

Although the Reference Model has been developed for data transmission and telematic applications, its use in various aspects of ISDN standardization is under study also. For example, the principles and concepts of the Reference Model can be constructively applied to:

1. the specification of user-to-network and network-to-network (both ISDN-to-ISDN and ISDN-to-non-ISDN) interfaces;

2. the design of signaling, control, and management systems internal to the ISDN; and

3. the modelling of end-to-end procedures for voice communications.

8.1.3 CCITT Study Period 1981-1984

The VIIth Plenary Assembly took initiatives to translate the concept of integrated digital services offered on one global digital network from futuristic vision to significant contemporary scientific thought and action. Three major decisions made by the 1980 assembly were:

1. formal recognition that it was a global imperative to devise necessary principles, strategies, and recommended standards for the future ISDN;

2. identification of numerous key issues; and

3. restructuring of its study-group organization on the basis of ISDN issues, assigning Study Group XVIII responsibility for coordination of the ISDN studies.

Because of the implications the ISDN concept holds for the future, and because this major effort was accomplished concurrently with the ISO restructuring initiatives to accommodate work on the OSI Reference Model

system of standards, extensive worldwide attention became focused on the ISDN. During 1981, "the number of documents and articles concerning ISDN issues went from almost none to nearly one thousand" (Datapro, 1983). By early 1983, some telecommunication providers worldwide were highlighting ISDN in their advertisements.

The Integrated Digital Network (IDN) upon which the ISDN was conceptually built had been formally described for the first time in the 1972 CCITT Recommendation G.702. The milestone 1980 Recommendation, G.705, set out preliminary ideas for the ISDN upon which the present work is built. The basic concept was the use of a digitized telephone network, using programmable digital switches and digital transmission paths, to establish connections for different services. The development of this concept and the importance of the changes in it for the United States are discussed below in Section 8.2.

By the middle of the 1981-1984 Study Period, two aspects of the CCITT work on the ISDN had become clear: the evolutionary nature of the network development process and the drawbacks that would have to be overcome.

The evolution of the ISDN can be viewed as having the following three phases:

1. the digital telephone network will evolve from the analog telephone network by implementing progressively digital transmission and digital switching and will provide 64 Kb/s connectivity as prerequisite for the ISDN;

2. the 64 Kb/s ISDN that will evolve from the 64 Kb/s telephone network will be enhanced by access capabilities for other services provided by the user or other specialized networks ("ISDN user/network interfaces");

3. the < and > 64 Kb/s ISDN that will evolve from the 64 Kb/s ISDN will incorporate additional capabilities for < 64 Kb/s and > 64 Kb/s at a later stage (Irmer, 1983).

The drawbacks listed below are those pointed out by Theodor Irmer, then Chairman of Study Group XVIII and the elected CCITT director for the 1985-1988 Study Period. According to Irmer, an understanding of these points is of considerable importance because "[i]f we do not respect these drawbacks we will either never get any Recommendations at all or only Recommendations which are not meaningful in practice" (Irmer, 1983).

Four major drawbacks defined by Irmer are:

1. the evolutionary phases are not neatly following each other but some developments from all three phases are more or less parallel at the same time;

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2. the uncertainties that exist about the demand for and requirements of "new services" to be integrated in the future;

3. not only do the responsibility and authority for services (and therefore legal situations) vary from country to country, but this is undergoing permanent change and modification in certain countries; and

4. the digital techology that must be implemented in an ISDN differs in size and speed in many countries.

Irmer concludes that these drawbacks imply that only a synergetic approach is possible for the evolution of the ISDN. ("Synergetic" means that agreement should be reached progressively on those parts of the ISDN for which it is possible, e.g., user/network interfaces.) Other issues will have to be left blank as long as no agreed-upon position exists. "Standardization of the ISDN must therefore be open ended and will be a task which cannot be completed fully in a short time."

8.2 The Importance of U.S. Participation in CCITT ISDN Studies

The evolution of the ISDN concept in the CCITT since 1980 is an excellent example of the importance of U.S. participation in international standardization efforts. In this case, the United States has acted largely in a mode of reaction to issues presented by others, because Europe has pursued ISDN standardization more aggressively than the United States. (More will be said about this below.) Even so, this is a situation where U.S. presence has made a measurable difference.

The original idea of the ISDN in the CCITT at the time of the 1980 Plenary Assembly involved the perception that a fully digitized telephone network might not be "conscious" of the actual nature of the original form of the bits passing through (whether voice, facsimile, data, etc.). This was based on a concept of the ISDN as a real, physical, end-to-end network. In certain national environments, particularly that of the United States, this led to the concept of multiple ISDN's, and to discussions of the interconnection of multiple, national ISDN's, and of ISDN's connected, for example, to specialized data networks (NTIA, 1983). The "ISDN" descriptor began to require adjectives: international, national, multi, etc.

There has been a growing recognition in CCITT work that the above concept is over-simplified, and that in the real world the network is not necessarily oblivious to the kinds of "information" passing through. The facilities needed for one service might be incompatible with the requirements for

transparency associated with another. One of the CCITT Recommendations on the ISDN prepared for the 1984 Plenary Assembly, I-310, introduced the concept that an ISDN may be defined as a network to which users are connected through a limited set of multipurpose ISDN user/network interfaces. The emphasis is strongly on the user/network interface characteristics. From this, it is but a small step to accept that:

> a conglomerate of networks, not necessarily having the same characteristics, mutually interconnected and which the subscribers access via standardized ISDN interfaces would qualify as 'an ISDN.' (de Haas, 1983, private communication).

This concept has not yet permeated all of the Draft Recommendations, but it is gaining recognition in the CCITT.

The fact that this concept fits well with the U.S. telecommunication environment is due to the hard work of the U.S. delegations to the CCITT study group meetings. The representations made by the U.S. delegates have played a major role in this change of emphasis.

It is generally accepted that several independent networks will exist side by side in an ISDN-like environment for several years to come. In speaking of the public networks' role in shaping the ISDN, Irwin Dorros, head of the technical division of Bell Communications Research Inc. (see Section 4.2.2), stated:

> The most attractive feature of the ISDN concept to the existing public network exchange carriers is that it allows an evolution toward Information Age services without knowing what the demand mix of these services will be. Since it takes many years to evolve these large and ubiquitous networks to new capabilities, by having a network target architecture that is robust to service forecast uncertainties, we can confidently invest in the future. If indeed all access to other networks and information services will be carried on a "digital pipe" of appropriate cross section, any mix of services will be accommodated in the mature ISDN era. Carriers will thereby ensure that they will not find themselves with the wrong capabilities 10 years from now (Dorros, 1983).

For any individual public ISDN, the key goals should include easy interconnection of terminals to the network, easy use of the network, and maximum possible connectivity, both within the network and between the network and other ISDNs. In achieving these goals, public carriers may play major roles in shaping the ISDN environment through:

1. offering widespread public access to ISDN's after characterizing user needs;

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2. planning ISDN's that utilize the existing telecommunication network as a base;

3. introducing evolutionary pre-ISDN digital capabilities to test markets and services; and

4. working in the organizations presently shaping ISDN standards.

This last role applies as well to users and manufacturers as it does to providers.

8.3 The Direction Standardization is Taking and the Organizations Involved

Although the studies and standardization of the ISDN are still in a basic stage, there are several criteria established for the global ISDN--i.e., the international connection of digital multi-service networks--that are directing these efforts. These criteria apply as well to the multi-ISDN environment envisioned for the United States. Among the major agreements are:

1. a limited number of standard interfaces between the customer and the network must be developed to permit the customer to choose conveniently among the various digital-network capabilities;

2. the network services should be totally integrated from the customer's point of view to provide flexibility and economy;

3. the customer should be able to control the network services to meet specific demands; and

4. there should be economical, common network management, maintenance, and operations functions (Falconer and Powers, 1983).

The ultimate goal of ISDN standardization efforts is the standardization of international digital interfaces, over which the widest possible range of services will one day be carried. The complex task facing the designers of the national networks includes "seeing" far enough into the future so that the design of today's multi-million (and maybe multi-billion) dollar investments in ISDN-directed equipment will be as adequate as possible for the year 2,000 and beyond. This means that national networks must be designed today for adaptation to tomorrow's interfaces and yet-unplanned services. How to do this without constraining the potential new services to today's concepts offers a challenge never faced before by telecommunication planners. The ISDN, in broad concept, is viewed as that framework within which the evolution of today's networks can occur alongside the evolving technology.

The successful conquest of the challenge facing the planners is dependent upon the standards being developed to define the ISDN framework. These standards must be flexible and adaptable to the various combinations of

equipment found in networks worldwide, and must be performance, not design, oriented.

Table 11 lists several major international, regional, and U.S. standards organizations that are either active in the development of ISDN and ISDN-related standards (Column I) or significantly interested and increasingly active in these activities (Column II). This latter interest stems largely from the importance of ISDN work to the OSI Reference Model or other information-processing related standards work.

The following sections discuss the ISDN standards activities of three of the organizations in column 1 of Table 11—CCITT, CCIR, and CEPT. Of these, the CCITT and CEPT are most actively involved. The activities of the four U.S. organizations in column 1, discussed elsewhere in this report, are summarized in Section 8.3.4.

8.3.1 The CCITT

The CCITT's ISDN studies involve several efforts including switching, signaling, and tariff principles in addition to services and network integration. The development of Signalling System No. 7, for example, was accomplished with the ISDN in mind. The development of the user-network interfaces has been the first major technical concern, including the physical, electrical, protocol, service, and performance characteristics of the interface(s). Table 12 summarizes the major efforts within the CCITT study groups.

Table 11. Sample Organizations Involved in ISDN Studies and
Standardization Efforts

	Groups with major interest		Groups involved	
INTERNATIONAL	CCITT:	SG's VII, VIII, XI, XVII, XVIII	CCITT:	SG's I, II, III, IX, XV
	CCIR:	SG 4	ISO:	TC97 (e.g., SC6 and SC16)
			IEC:	TC83
REGIONAL	CEPT: GSI		ECMA:	TC's 23, 24, 25
UNITED STATES	U.S. CCITT:	ISDN Joint Working Party	EIA:	TR's 29, 30, 40
			IEEE:	Project 802 (and Telecommunication Committee)
	FCC: CCB			
	ASC T1: T1D1			
	NCS: FTSP		NBS/ICST:	FIPS Program
			ANSC X3:	e.g., X3S3, X3T5

Table 12. Major CCITT Study Group Involvement in ISDN Studies

Study Group*	Responsibilities
XVIII: Digital Networks	ISDN coordination, setting of fundamental concepts, foundations, and directives; identification of ISDN interface requirements
VII: Data Communication Networks	Data-related matters for ISDN, including use of the ISDN interface to support circuit and packet switching, and adaptation of existing data interfaces
XI: Telephone Switching and Signaling	Signaling protocols for ISDN interface, including CBX signaling
XVII: Data Communication Over the Telephone Network	Examining physical level issues for an interface common to ISDN, public data networks, and modems

*Other Study Groups are involved, but to a lesser extent.

The CCITT (Study Group XVIII) has defined a new Recommendation series, the I-series, that places all general ISDN-relevant Recommendations in one single series, rather than having them scattered over existing series (e.g., G, X, Q). The I-series will provide principles and guidelines on the ISDN concept, as well as detailed specifications of the user-network and internetwork interfaces. They will contain suitable references so that the detailed Recommendations on specific elements within the network can continue to be developed in the appropriate Recommendation series. The I-series Recommendations will be developed by various study groups. The six-part structure of the I-series is:

    Part I: General ISDN Concept (terminology, structure of Recommendations, general methods, etc.)
    Part II: Service Capabilities
    Part III: Overall Network Aspects and Functions
    Part IV: User-Network Interfaces
    Part V: Internetwork Interfaces
    Part VI: Maintenance Principles

An ISDN will be recognized by the service characteristics it offers (for example procedural and performance) that can be identified at the user/network interface rather than by any ISDN architectural configuration. Therefore, the I-Series Recommendations have an access-interface perspective to provide implementation flexibility. The functional, user-oriented set of protocols

follows a layered interface approach (discussed below in Section 9). Sample
service requirements for home and business are listed in Table 13 (Bhusri,
1984). These requirements are based on the primary rate B-channel (64 Kb/s),
and the variable rate D-channel (4-64 Kb/s).

Table 14 lists the Recommendations in this series as defined in
Recommendation I.110 (CCITT, 1984f). These Recommendations were presented for
approval to the VIIIth Plenary Assembly in 1984. Other I-series
Recommendations will be studied in the 1985-1988 Study Period.

8.3.2 The CCIR

The International Radio Consultative Committee (CCIR) is particularly
interested in ISDN studies relative to digital transmission in a broadcast
mode. The role of the satellite link in the hypothetical reference
connection, the associated performance characteristics, and the performance of
digital radio relay systems are examples of CCIR ISDN studies.

The following paragraph, selected from the CCITT Recommendation I.120
(which replaces the 1980 Recommendation G.705), defines the importance of CCIR
contributions to this effort, and their relationship to CCITT studies:

> In the evolution towards an ISDN, digital end-to-end connectivity
> will be obtained via plant and equipment used in existing networks,
> such as digital transmission, time-division multiplex switching
> and/or space division multiplex switching. Existent relevant
> Recommendations for these constituent elements of an ISDN are
> contained in the appropriate series of Recommendations of CCITT and
> CCIR (CCITT, 1984d).

8.3.3 The CEPT

The focus of telecommunication standards harmonization in Europe is the
European Conference of Postal and Telecommunications Administrations (CEPT).
The CEPT, founded in 1959, facilitates cooperation among 26 national PTT's.
The combined geographical area represented by the CEPT membership,
approximately equal to that of the United States, represents a highly
developed technological region that is divided into many different political
and cultural entities. The decisions made in CEPT have a marked influence on
worldwide standardization efforts because the CEPT position influences 26
votes in CCITT.

The projects of major importance in CEPT are: Guidelines for ISDN,
Digital Transmission Systems for Cable and Microwave Links, Digital Switching
Systems, Equipment Design, and New Services (teletex, digital facsimile, and

Table 13. Sample ISDN Service Requirements for Home (Part A) and Business (Part B)

Part A: Service Requirements for the Home

Service	Bandwidth Requirement	ISDN Channel Type		Facilities			
		B	D	Circuit Switched	Packet Switched	Channel Switched	Overlay
Telephone	8,16,32,64 kb/s	X		X			
Alarms Smoke Fire Police Medical	10-100 b/s		X				
Utility Metering	0.1-1.0 kb/s		X	X	X		
Energy Management	0.1-1.0 kb/s		X	X	X		
Interactive Information Services (View Data) Electronic Banking Electronic Yellow Pages Opinion Polling	4.8-64 kb/s	X			X		
Electronic Mail	4.8-64 kb/s	X			X		
Broadcast Video	96 Mb/s					X	X
Switched Video	96 Mb/s					X	X
Interactive Video	96 Mb/s			X		X	X

Part B: Service Requirements for Business

Service	Bandwidth Requirement	ISDN Channel Type		Facilities			
		B	D	Circuit Switched	Packet Switched	Channel Switched	Overlay
Telephone	8,16,32,64 kb/s	X		X			
Interactive Data Communications	4.8-64 kb/s	X	X		X		
Electronic Mail	4.8-64 kb/s	X			X		
Bulk Data Transfer	4.8-64 kb/s	X		X			
Facsimile/Graphics	4.8-64 kb/s	X		X			
Slow Scan/ Freeze Frame TV	56-64 kb/s	X		X			
Compressed Video Conference	1.544 Mb/s (T$_1$ Rate)					X	X

Table 14. The I-Series Recommendations (CCITT, 1984f)

No.	Title

Part I. General

I.110   General structure of the I-Series Recommendations
I.111   Relationship with other Recommendations relevant to ISDNs
I.112   Vocabulary of terms for ISDNs
I.120   Integrated Services Digital Networks (ISDNs) (was G.705)
I.130   Attributes for characterization of telecommunication services supported by an ISDN and network capabilities of an ISDN

Part II. Service Capabilities

I.210   Principles of Telecommunication Services Supported by an ISDN
I.211   Bearer Services Supported by an ISDN
I.212   Tele-Services Supported by an ISDN

Part III. Overall Network Aspects and Functions

I.310   ISDN - Network Functional Principles
I.320   ISDN Protocol reference model
I.32x* ISDN Architecture functional model
I.32y* ISDN Hypothetical reference connections
I.330   ISDN Numbering and addressing principles
I.331   (E.164) The numbering plan for the ISDN era
I.33x* ISDN Routing principles
I.340   ISDN Connection Types
I.35x* ISDN Performance objectives relating to circuit-switched connections. (For further study, see Question M/XVIII.)
I.35y* ISDN Performance objectives relating to packet-switched connections. (For further study, see Question M/XVIII.)

Part IV. User-Network Interfaces

I.410   General aspects and principles relating to Recommendations on ISDN user-network interfaces
I.411   ISDN user-network interfaces - reference configurations
I.412   ISDN user-network interfaces - channel structures and access capabilities
I.420   Basic user-network interface
I.421   Primary rate user-network interface
I.430   Basic user-network interface - Layer 1 specification
I.431   Primary rate user-network interface - Layer 1 specification
I.43x* Higher rate user-network interfaces. (For further study, see Question L/XVIII.)

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Table 14. (continued)

No.	Title

Part IV. User-Network Interfaces (continued)

No.	Title
I.440	(Q.920) ISDN user-network interface data link layer - general aspects
I.441	(Q.921) ISDN user-network interface data link layer specification
I.450	(Q.930) ISDN user-network interface layer 3 general aspects
I.451	(Q.931) ISDN user-network interface layer 3 specifications
I.460	Multiplexing, rate adaption and support of existing interfaces
I.461	(X.30) Support of X.21 and X.21bis based DTEs by an ISDN
I.462	(X.31) Support of Packet Mode Terminal equipment by an ISDN
I.463	(V.110) Support of DTEs with V-series type interfaces by an ISDN
I.464	Rate adaption, multiplexing and support of existing interfaces for Restricted 64 kb/s transfer capability

*Not ready for approval by the VIIIth Plenary Assembly, October 1984.

videotex). The future projects include: Cordless Telephones, Optical Waveguides, and Harmonization of Mobile Services.

The work on the new services addresses their transmission on existing networks. The CEPT specifications drafted for the subscriber interface will facilitate liberalization of the market for telematic terminals. CEPT also views these specifications as a model for future subscriber interfaces on the ISDN.

At present, a strong emphasis in CEPT is on ISDN standardization. This emphasis is market based and can be traced, at least in part, to a 1976 announcement by the European Economic Community (EEC) of plans to open the European market to telecommunication products and systems:

> . . . the harmonization of the technical standards in telecommunications is an essential element in ensuring competition in awarding delivery contracts for telecommunication systems at the community level (Martin, 1983).

Although the membership of EEC is smaller than that of CEPT, the EEC member countries proposed that this work be carried out in CEPT. This has led to harmonization with respect to telecommunication terminals and the ISDN as a prerequisite for opening the markets.

For many decades, the telecommunication systems of Europe have been interoperable based on CCITT Recommendations. For some countries, (e.g., France), the CCITT Recommendations are the national standards. However, this basis was not considered a sufficient foundation upon which to build a newly enlarged European market because:

> . . . the goal of the effort to open the market is not merely to create better conditions for PTT's as a result of the enlarged market framework, but also to improve the opportunities of the manufacturing industry.

> The standards that result from the harmonization work of the CEPT include, in addition to recommendations selected from several options offered by the CCITT, detailed recommendations, such as those dealing with safety requirements or regulations for connecting equipment to the public network. CEPT recommendations mean independent standards, as long as worldwide recommendations are not likely to be established in the near future (Martin, 1983).

Among the CEPT working groups is the Special Group on the ISDN (GSI). The main tasks relate to supply of services and their features, network structures and strategies for their introduction, demands in the transmission equipment, guidelines for the physical interfaces at the exchanges and at

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subscriber terminals, and guidelines for signaling. This work is supported by European manufacturers and by the European Conference of Associations of Telecommunications Industries (EUCATEL), and to the extent permitted by CEPT bylaws, industry is cooperating in the development of such standards at the national and European levels.

Because CEPT laid so much stress on ISDN standards in 1980 and 1981, the work in CEPT has acted as a catalyst to the process in CCITT. Conversely, the CCITT work has been especially important to CEPT in its development of the appropriate recommendations.

As early as November 1982, GSI was able to produce a report to "document the results of CEPT studies of general assumptions, policies and strategies for evolution towards an ISDN in Europe" (CEPT, 1982). The objectives of this report were to give reasons for introducing an ISDN, to define a common CEPT approach, and to formulate the service objectives seen from the customer and Administration viewpoints. The 83-page report has served as a general reference document for more detailed ISDN studies in CEPT.

8.3.4 The U.S. Organizations

The U.S. CCITT and its goals were addressed in Section 7.3.3. The ISDN Joint Working Party is involved in studying ISDN contributions to the CCITT from the United States. From whatever source, these contributions must pass through this group.

The newly formed telecommunications committee, ASC T1, was discussed in Section 5.4.3. Among its goals is the development of international standards contributions relating to the emerging ISDN. The activities of the former Technical Working Group in the U.S. CCITT ISDN Joint Working Party are now the responsibility of the T1 ISDN TSC T1D1 (see Section 5.4.3).

The interest of the FCC in ISDN issues was outlined in Section 4.2.2.

The final U.S. organization to be addressed here, relative to its interest in ISDN standardization, is the National Communications System (NCS), discussed in Section 4.4. The potential impact of the ISDN on the NCS mission of enhancing Federal emergency communication preparedness is substantial. In addition to participating in the standards work of other organizations, NCS is planning an ISDN standard among its 1983-87 FTSP standards projects.

9. THE OSI REFERENCE MODEL AND WORLDWIDE STANDARDIZATION EFFORTS

The telecommunication developments during the late 60's and early 70's, that eventually combined to propel the traditionally staid CCITT into public world view as the focus of ISDN studies, had their counterparts in the computer world. These computer developments brought the International Organization for Standardization into prominence for its origination of the Open Systems Interconnection (OSI) Reference Model.

The forces at work included the accelerating development of computer technology, the decreasing cost of computers and computer services, the increasing problems associated with the inability of different-vendor computers to "talk" to each other, and the steady increase of data communications for an ever increasing number of applications. In 1977, the ISO became involved, through TC97, in the development of a system of standards designed to provide a systematic means for computers to communicate regardless of design or manufacturer. This "systematic means" came to be known as the OSI Reference Model, and is often simply referred to as "OSI."

This section offers the general background leading to the OSI Reference Model and traces the standards work being done on the related protocols and service definitions by several standards organizations. In particular, the significant role being played by the CCITT in the OSI work, in conjunction with ISO, is outlined (see Appendix E.3). The OSI discussion in this section is presented as a second example (the ISDN discussion in Section 8 is the other) of the planned interdisciplinary system of standards (Section 6.1.2). Furthermore, Section 9 also illustrates the "proactive" approach to standards development discussed in Section 6.2. In the work on the OSI, the international standards community "recognized the potential for open systems interconnection and the advantages of agreeing upon world standards ahead of the market demand" (Langsford, 1982). In reference to the work of TC97/SC16, the committee that initiated the OSI studies, it has been said:

> In most cases, the job of a standards committee is to take sets of commercial practices and the current research results when applicable and codify these procedures into a single standard that can be utilized by commercial products. SC16 was presented with a somewhat different problem: develop a set of standards which emerging products could converge to before the commercial practices were in place and while many of the more fundamental research problems remained unsolved. It would be presumptious to say that SC16 solved this problem. They did, however, find a way to cope with the problem in such a way as to maximize flexibility and to

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minimize the impact of change brought on by new technologies or new techniques (Day and Zimmerman, 1983).

Much of the general background material has been selected from the December 1983 special issue of Proceedings of the IEEE, which is dedicated to the Open Systems Interconnection Reference Model. The comprehensive nature of the set of papers, as well as the authoritative views of the authors, provides timely, ready-made source of OSI information not readily obtainable in such concise format. The interested reader is referred to the entire edition; only 3 of the 22 articles are referenced here.

9.1 The Background of the Development of OSI Studies

The early 60's witnessed the beginnings of international standards work on information systems and data communications in ISO TC97, "Information Processing Systems," and in CCITT Special Study Group A (now SG XVII), "Data Transmission over Telephone Networks." In addition, ECMA and many national standards bodies established standards development activities to deal with the newly emerging computer technology.

By the late 60's and early 70's, the computer user was generally able to "talk" to another like computer (of same manufacturer) over the public switched telephone network, making use of standardized physical interfaces such as EIA's RS-232 and CCITT's V.24 and V.28. The interfaces offered a clear distinction between the computer and the network.

In the early 70's, ISO proceeded with its development of "bit oriented" data link protocols for data transmission. In 1972, the CCITT, in recognition of the need for telecommunication services specifically tailored for data communication applications, established SG VII, "Public Data Networks." The ISO has always maintained close liaison with CCITT's Public Data Network activity.

Major changes were taking place at this time that erased forever the early 70's clear distinction between data processing and telecommunications. Among these were:

1. the users' DTEs became both more numerous and more capable, eventually leading away from centralized computer intelligence and toward distributed information processing; and

2. the introduction of private and public data networks, both circuit switched and packet switched, required new interfaces and complex protocols tying together the end user's equipment and the network in new ways typically via computers within the network.

Although numerous standardization efforts around the world were developing specifications,

> . . . there was no master plan that would ensure that all system aspects and requirements were being addressed appropriately. Only standards dealing with the transmission of digital information were produced, and they did not ensure that full and meaningful communications could take place in an international heterogeneous environment. While there are many widely distributed user systems that are of different designs and different manufacture, the established standards have enabled bits of digital information to be transferred among them, but the information is very likely to be useless to the destination unless there is full compatibility in design.

> This situation left many questions to be answered. While individual systems operate satisfactorily in their own "closed" environment, what is needed for them to become "open" so they can freely communicate with others? What orderly structure is needed for applications and requirements to be analyzed on a common basis? What standards are needed for creation of an "open systems environment" that will enable a continuing evolution for new requirements and advancing technology? (Folts, 1983)

9.2 TC97 SC16 and the OSI Reference Model

In 1977, ISO TC97 established SC16 to address the problems on Open Systems Interconnection. The task of SC16 was to develop a reference model that would provide an architecture to serve as a basis for all future development of standards for worldwide distributed information systems.

By mid-1979, the first draft of a 7-layered reference model was distributed by TC97 SC16. Four revisions later, in May 1983, ISO International Standard 7498, "Open Systems Interconnection - Basic Reference Model," received final approval. The relation of IS 7498 to the CCITT Recommendation X.200, "Reference Model of Open Systems Interconnection for CCITT Applications," is discussed below in Section 9.3.

9.2.1 The Meaning of a Reference Model

The term "Reference Model" has come to have a specific meaning in relation to national and international standardization. A reference model is:

> . . . a descriptive framework of a complex process from which the interrelationships among functions can be determined and rational decision making processes applied to identify what is both necessary and desirable to standardize in a public way in order to permit effective functioning of the process in question (Steele, 1983).

A core aspect, therefore, of the OSI Reference Model is that in itself it is not a formal technical standard serving as an implementation specification, nor is it a basis for appraising conformance of existing networks. Rather, it is a framework upon which a system of related standards can be built. It is "more" than a concept, (e.g, ISDN), but is is "less" than a specific standard or group of standards (e.g., CCITT Signalling System No. 7).

9.2.2 The Meaning of Architecture in the OSI Reference Model

The approach used by SC16 in developing its Reference Model was to use a layered architecture to:

> break up the problem into manageable pieces. . . . In OSI, the problem is approached in a top-down fashion, starting with a description at a high level of abstraction which imposes few constraints, and proceeding to more and more refined descriptions with tighter and tighter constraints. In the world of OSI, three levels of abstraction are explicitly recognized: the architecture, the service specifications, and the protocol specifications. . . . The OSI Architecture is the highest level of abstraction in the OSI scheme (Day and Zimmerman, 1983).

The term "architecture" has a specific meaning in the context of IS 7498. A good way to think about its meaning is to consider an architecture, such as Victorian with all its related rules, and a building constructed to that architecture (Day and Zimmerman, 1983). The elements of the OSI architecture, or the building blocks that are used to construct the 7-layered model, are described in the first major section of IS 7498. These layers are summarized in Section 9.2.4.

The two lower levels of abstraction in the OSI Reference Model, service and protocol specifications, define, respectively, the service provided by each layer, and precisely what control information is to be sent and what procedures are to be used to interpret this control information.

Since the purpose of OSI is to allow any two (or more) computers in the world to communicate as long as each "obeys" OSI standards, the degree of compatibility required to meet this goal makes formal description methods a necessity. The TC97 subcommittee on Architecture (SC16/WG1) established a group early in its work to develop formal description methods for defining the protocols so that they could be implemented unambiguously by people all over the world without having to consult with a few experts on how to interpret the standard.

9.2.3 Why a Layered Architecture

The system in an Open Systems Interconnection is considered to be one or more autonomous computers and their associated software, peripherals, and users that are capable of information processing and/or transfer. Layering is used as a "structuring technique to allow the network of open systems to be logically decomposed in independent, smaller subsystems (Day and Zimmerman, 1983)."

Two of the basic principles of layering are:

1. each layer adds value to services provided by the set of lower layers in such a way that the highest layer is offered the full set of services needed to run distributed applications;

2. layering ensures layer independence by defining services provided by a layer to the next higher layer, independent of how these services are performed. This permits changes to be made in the way a layer or a set of layers operate, provided they still offer the same service to the next higher layer. (Not all functions performed within a layer are services. Only those capabilities that can be seen from the layer above are termed services.)(After Day and Zimmerman, 1984.)

9.2.4 The Seven Layers

In this hierarchical, layered structure, layers 1-4 are termed "lower" and layers 5-7 are "upper" or "higher." Only the highest, the Application layer, communicates with end users or Application Processes (APs) directly. All other layers support APs indirectly via a step-by-step enhancement of the basic communication capability provided by the physical media. The Reference Model is concerned only with the external behavior of real systems, not their internal structures.

The seven layers are described briefly below:

1. <u>Physical Layer</u>: The Physical layer provides transparent transmission bit stream over a circuit built in some physical communications medium.

2. <u>Data Link Layer</u>: The Data Link layer overcomes the limitations inherent in physical circuits and allows errors in transmission to be detected and recovered, thereby masking deficiencies in transmission quality.

3. <u>Network Layer</u>: The Network layer transfers data transparently, selecting a route and directing the data accordingly.

4. <u>Transport Layer</u>: The Transport layer provides end user to end user transfer, optimizing the use of resources according to the type and character of the communication, and relieves the user of any concern for details of the transfer.

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5. Session Layer: The Session layer co-ordinates the interaction within each association between communicating application processes.

6. Presentation Layer. The Presentation layer transforms the syntax of the data which is to be transferred into a form recognizable by the communicating application processes.

7. Application Layer: The Application layer specifies the nature of the communication required to satisfy the user's needs. This is the highest layer in the Model and so does not have a boundary with a higher layer. The Application layer provides the sole means for application processes to access the OSI environment (CCITT, 1983).

The OSI Reference Model evolved from a rich background of research in networks, proprietary network architectures, and developed products. Within the industry there was general approval of the layered approach. Table 15 (Tannenbaum, 1981) describes the approximate correspondences between the layered structures of three of these networks, and the OSI Reference Model.

Figure 23 represents the OSI environment for two end-to-end users with intermediate nodes that have functionality of only the lower three layers. The information flow can go in either direction. The lower three layers of the Model--Physical, Data Link, and Network--apply to the communication media, and the service offered collectively by these three layers to the Transport layer is called the "Network Service." The Network Service (NS) offers a standard, conceptual end-to-end communication capability that is independent of the type(s) of communication media involved.

The service offered collectively by the lower four layers--Physical, Data Link, Network, and Transport--is called the "Transport Service". The primary objective of the transport layer is to "provide to the Session layer, data transportation at a required Quality of Service (QOS) in an optimum manner. The Transport layer thus 'bridges' the quality of service 'gap' between that required by the Session layer and offered by the Network layer" (Knightson, 1983).

The upper three layers--Session, Presentation, and Application--are concerned with the users of the transport service. The upper layers deal with the processes that insure cooperation of the end systems and of the activities that support the cooperating APs.

9.3 The CCITT and the OSI Reference Model

Because data communications is impossible without telecommunication networks, and because the CCITT had already established Study Group VII in the early 70's to study Data Communication Networks, the establishment of SC16 by

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Table 15. The Approximate Correspondence Between the Layers of the OSI
Reference Model and Three Other Architectures

| Layer	ISO	ARPANET	SNA	DECNET
7	Application	User	End user	Application
6	Presentation	Telnet, FTP	NAU services	
5	Session	(None)	Data flow control	(None)
4	Transport	Host-host	Transmission control	Network services
3	Network	Source to destination IMP	Path control	Transport
2	Data link	IMP-IMP	Data link control	Data link control
1	Physical	Physical	Physical	Physical
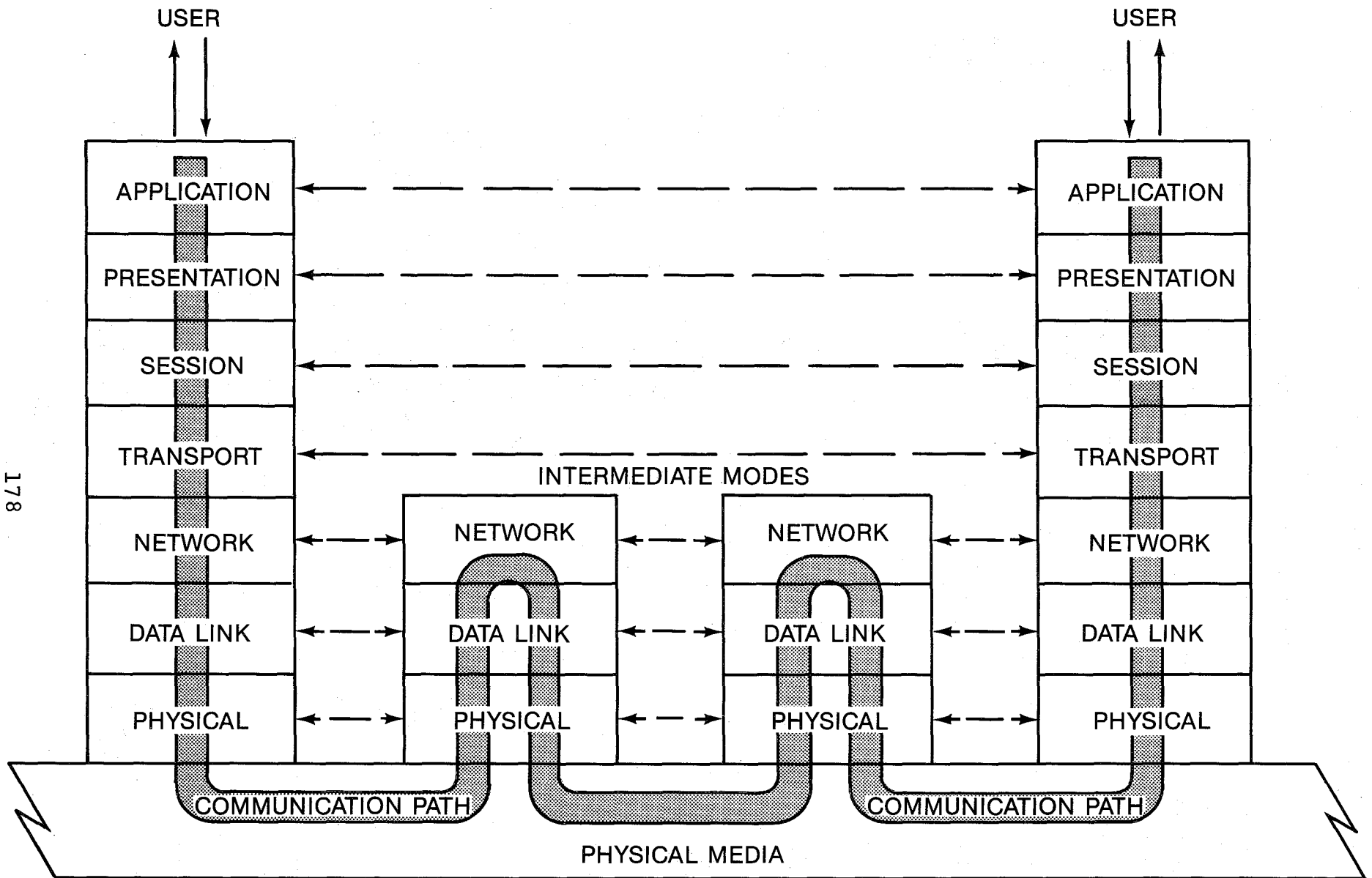
Figure 23. The Open Systems Interconnection (OSI) environment between two
end users, indicating two intermediate nodes having functionality
only to the Network Layer.

ISO marked a new and unprecedented overlap of activities by the two international organizations. CCITT quickly responded by establishing a Rapporteur's Group on "The Reference Model for Public Data Networks." The resultant Recommendation X.200 (that received early approval in 1983 and final approval in 1984) is now titled "Reference Model of Open Systems Interconnection for CCITT Applications."

For 6 years, as both CCITT and ISO worked on the reference model, anxiety existed worldwide that two models would emerge and would consequently produce almost insurmountable difficulties. The agreement between CCITT and ISO that eventually resulted in two virtually identical models represents coordinated efforts by experts from both organizations. The technical and political advantages accruing to their success can only be measured by contemplating the alternative!

9.3.1 The CCITT's Response to Data Communications

The CCITT has been responding to the mushrooming development of new and low-cost terminal equipment since the late 60's. Three approaches taken are summarized as follows:

> The first approach of CCITT has been to accommodate new applications in existing networks under specified technical conditions (i.e. interface conditions). The second approach is the active network support of customer-defined applications including the definition of a general protocol architecture above pure network requirements to promote system compatibility. The third approach is the provision of standards for CCITT end-to-end defined services, in the same spirit as for telex but on a much more advanced and sophisticated basis: the telematic services (Hummel and Staudinger, 1983).

The 14 years of CCITT involvement in data-related activities has shown that an efficient promotion of data communications needs more than just the provision of network support. The growth of the data terminal population has been permanently hampered by the lack of compatibility:

> Certainly, the standardization of the V and X Series interfaces (V.24, V.25, X.20 and X.21) has greatly helped the accommodation of data terminal equipment in the public telephone and data networks. However, these interfaces brought to light, even more painfully for the customer, that standardization of the lower levels is not sufficient as a number of data and telematic systems differ, for the same service, in many aspects from each other at the higher levels. The definition of X.25 (packet-switching interface) was an attempt to achieve a higher degree of compatibility, but X.25 still

provides compatibility at the lower levels only (Hummel and Staudinger, 1983).

The CCITT has a vital interest in the higher levels, also. This interest is derived from 3 principal concerns:

1. the increasing degree of interdependence of the data processing and data transport functions in the context of the total "information" system;

2. the apparent desire to maintain a reasonably clean line of functional demarcation between these functions (so that the "transport service" can be progressively optimized on a modular basis as a constant-entropy data transport system while imposing a minimum of constraints on the user); and

3. the recognition that certain data processing functions at levels 5, 6, and 7 (e.g, packet assembly and disassembly, and network management) are incidental, but nevertheless essential to the design of an efficient data transport service (NCS, 1983).

For all of the above reasons, the CCITT is, as policy, structuring all new services into the 7 layers of the OSI Reference Model (see Table 16).

This policy, and the various ramifications implied, represents a radical change on the part of the CCITT, and "in accepting these new tasks, the CCITT has been changing from an administration-oriented organization to an open forum where any member may submit new and innovative ideas" (Hummel and Staudinger, 1983).

Table 16. The Layers of the OSI Model and Their Principal Functions for CCITT Services (Hummel and Staudinger, 1983)

	Layer	Principal Functions for CCITT-defined Services
7	APPLICATION	Characteristics of terminal equipment (description of the mandatory features and the standardized options)
6	PRESENTATION	Character repertoire and coding, presentation (page spacing, image type, resolution, etc.) and their negotiation
5	SESSION	Session control (service identification, terminal capabilities) and document control (document type, page, number, checkpoint, etc.)
4	TRANSPORT	Provides a network independent transport service including quality of service selection (throughput, delay, etc.)
3	NETWORK	Call control and data transfer procedures
2	LINK	Protection of call establishment and release control characters and of user data
1	PHYSICAL	Physical connections via the DTE/DCE interface

9.3.2 The CCITT Recommendations for End-to-End Services

A correspondence can be shown between the OSI Reference Model and the CCITT end-to-end service, teletex. Standardization for teletex, which combines functions of electronic typewriters and communications, was initiated in 1976. Table 17 (Hummel and Staudinger, 1983) shows the various CCITT Recommendations that are applicable to this service. Since all the seven layers are provided for, uniform implementation is ensured on a worldwide basis to achieve full international compatibility.

Table 17 is divided into two sections. Section 1, the transport service, indicates that teletex may be provided over circuit- or packet-switched data networks, or over the telephone network. Therefore, different access procedures are listed according to the network. The transport layer, however, is network independent, and so the same procedures, using Recommendation T.70 formerly S.70), can be used for all networks. Recommendation T.70 is also applicable to other services.

Section 2 of Table 17 indicates Recommendation T.62 (S.62) for level 5. This, like T.70, is designed for new network-independent CCITT end-to-end services (and also non-CCITT applications such as general data communication applications). (The titles of the Recommendations listed in Table 17 can be found in Section 9.4.)

Another CCITT end-to-end telematic service, the Message Handling Service (MHS), is an OSI-consistent service, and is, in fact, the first fully defined Application Layer Protocol for OSI. Section 9.4 contains the complete titles of the eight MHS Draft Recommendations developed in the 1981-1984 Study Period in SG VII.

9.4 Overview of Standardization Efforts for Open Systems Interconnection

Many organizations are involved worldwide in developing network/system interfaces, protocols, and service definitions based on the OSI Reference Model framework. Figure 24 presents an overview of organizations, both international and U.S., that contribute to OSI work. Table 18 indicates this activity for three international standards organizations discussed in this report (although activity is not limited to only these organizations). Table 19 lists the titles of the standards projects of Table 18, both those completed and those in process.

Table 17. The Applicable CCITT Recommendations for the
Teletex Service

	LAYER	NETWORK		
		PACKET SWITCHED PDN	CIRCUIT SWITCHED PDN	TELEPHONE
4	TRANSPORT	←————————— T.70 —————————→		
3	NET-WORK CALL CONTROL	X.25	X.21	TELEPHONE PROC. +X.25
	NET-WORK DATA TRANSFER	X.25	NULL	X.25 layer 3 procedure
2	LINK	LAP B/X.25	LAP B (X.75)	X.25 (duplex) or S.71 (half duplex)
1	PHYSICAL	X.21	X.21 OR X.22	V.24 manual or automatic V.25 operation

Layers 1-4

|	LAYER	TELETEX BASIC MODE	MIXED MODE	DIGITAL FACSIMILE BASIC MODE
7	APPLICATION	T.60/T.61	T.5/T.6 T.60/T.61	T.5/T.6
6	PRESENTATION		T.73	
5	SESSION	T.62		

Layers 5-7 for Telematic Services

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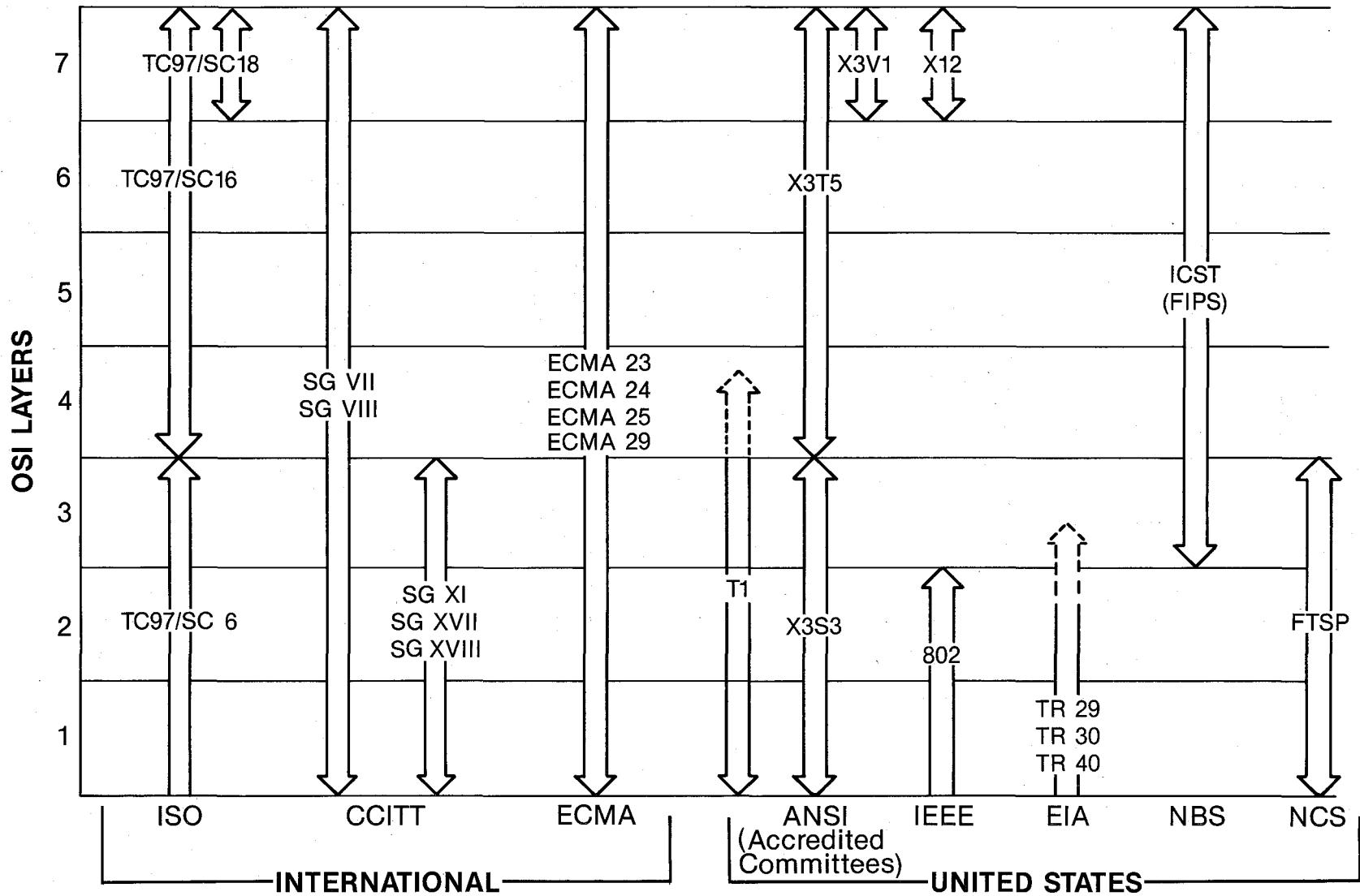
Figure 24. Selected international and U.S. standards organizations that contribute to OSI work. The layers of interest to each are indicated.

Table 18. A Listing of Representative Major International Standards
          and Work in Progress Related to the OSI Reference Model
          (see Table 19 for titles of all listed documents)

Layer	CCITT		ISO		ECMA
Reference Model	X.200(N) X.210(N)		IS 7498 97/16 DP 8509 97/16 N 1632	97/16 N 1656 97/16 N 1658	ECMA-92
7	X.217** X.400(N) X.401(N) X.408(N)	X.411(N) X.420(N) X.430(N)	97/16 DP 8571/2 97/16 DP 8571/3 97/16 DP 8571/4 97/16 N 1458 97/16 N 1662 97/16 N 1669 97/16 N 1674	97/16 N 1675 97/16 N 1713 97/16 N 1714 97/16 N 1715 97/16 N 1718 97/16 N 1719	ECMA-87 ECMA-88
7/6	F.200(R) T.60(R) T.61(R)	T.5(N) T.6(N) X.409(N) X.410(N)			
6	T.73(N) T.101(N) X.216**		97/16 N 1666 97/16 N 1667		ECMA-86
5	T.30(R) T.62(R) T.100(R)	X.215(N) X.225(N)	97/16 IS 8326 97/16 IS 8327		ECMA-75
4	T.70(R) X.214(N) X.224(N)		97/16 IS 8072 97/16 IS 8073 97/16 DP 8602 97/16 N 1699 97/16 N 1703		ECMA-72

Table 18. (continued)

Layer	CCITT	ISO	ECMA
3	X.21(R) X.70(R) X.213(N)	97/6 DIS 8348 97/6 DIS 8473 97/6 N 2916 97/6 N 2965 97/6 N 2969	
3/2	X.25(R) X.32(N) X.75(R)	97/6 DIS 8208	
2	T.71(N) X.212**	IS 4335 97/6 DP 2925 (IEEE 802/2)	
2/1	Appropriate ISDN Recommendations (See Section 9)	97/6 DP 2791 (IEEE 802/4) 97/6 DP 2792 (IEEE 802/3)	ECMA-RR
1	V.24(R) V.25(R) V.25bis(N) X.21(R) X.21bis(R) X.22 X.211**	97/6 N 2598	

(N) New Recommendation in 1981-1984 Plenary Period

(R) Revised Recommendation in 1981-1984 Plenary Period

** Not ready for approval by 1984 Plenary Assembly. (For further study.)

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Table 19.   Titles of the OSI-Related Standards and Documents
Listed in Table 18

Layer	Document No.	Title
Reference Model	X.200	Reference Model of Open Systems Interconnection for CCITT Applications
	X.210	OSI Layer Service Definition Conventions
	IS 7498	Information Processing Systems--Open Systems Interconnection--Basic Reference Model
	97/16 DP 8509	Service Conventions
	97/16 N 1632	Procedures for Handling Questions Related to the OSI Reference Model
	97/16 N 1656	Working Draft for an Addendum to IS 7498 to Align it with CCITT Rec. X.200
	97/16 N 1658	Working Draft for Addendum to IS 7498 Covering Connectionless Data Transmission
	ECMA-92	Connectionless Interworking Protocol
7	X.217	Common Application Service Definition
	X.400	Message Handling Systems: System Model-Service Elements
	X.401	Message Handling Systems: Basic Service Elements and Optional User Facilities
	X.408	Message Handling Systems: Encoded Information Type Conversion Rules
	X.411	Message Handling Systems: Message Transfer Layer
	X.420	Message Handling Systems: Interpersonal Messaging User Agent Layer
	X.430	Message Handling Systems: Access Protocol for Teletex Terminals
	97/16 DP 8571/2	File Transfer, Access and Management--Part 2: The Virtual Filestore
	97/16 DP 8571/3	File Transfer, Access and Management--Part 3: The File Service Definition
	97/16 DP 8571/4	File Transfer, Access and Management--Part 4: The File Protocol Specification
	97/16 N 1458	Job Transfer and Manipulation Concepts and Services
	97/16 N 1662	Common Application Service Elements and Protocols
	97/16 N 1669	Working Draft on File Transfer, Access and Management--General Description
	97/16 N 1674	Basic Class Virtual Terminal Service
	97/16 N 1675	Basic Class Virtual Terminal Protocol

Table 19. (continued)

Layer	Document No.	Title
7 (cont'd)	97/16 N 1713	Definition of Common Application Service Elements for Committment, Concurrency and Recovery
	97/16 N 1714	Protocol Specification for Committment, Concurrency and Recovery
	97/16 N 1715	Directory Service for OSI Systems
	97/16 N 1718	Control of Application Process Groups
	97/16 N 1719	OSI Management Framework
	ECMA-87	Generic Virtual Terminal--Services and Protocol Definition
	ECMA-88	Basic Class Virtual Terminal--Service Description and Protocol Definition
7/6	F.200	Teletex Service
	T.60	Terminal Equipment for Use in the Teletex Service (was S.60)
	T.61	Character Repertoire and Coded Character Sets for the International Teletex Service (was S.61)
	T.5	General Aspects of Group 4 Facsimile Apparatus
	T.6	Facsimile Coding Schemes and Coding Control Functions for Group 4 Facsimile Apparatus
	X.409	Message Handling Systems: Presentation Transfer Syntax and Notation
	X.410	Message Handling Systems: Remote Operations and Reliable Transfer Server
6	T.73	Document Interchange Protocol for the Telematic Services
	T.101	International Interworking for Videotex Services
	X.216	Presentation Layer Service Definition for Open Systems Interconnection for CCITT Application
	97/16 N 1666	Connection Oriented Presentation Service Definition
	97/16 N 1667	Connection Oriented Presentation Protocol Definition
	ECMA-86	Generic Data Presentation--Services Description and Protocol Definition
5	T.30	Procedures for Document Facsimile Transmission in the General Switched Telephone Network
	T.62	Control Procedures for the Telex and Group 4 Facsimile Services (was S.62)

Table 19. (continued)

Layer	Document No.	Title
5 (cont'd)	T.100	International Information Exchange for Inter-active Videotex (was S.100)
	X.215	Session Service Definition for Open Systems Interconnection for CCITT Applications
	X.225	Session Protocol Specification for Open Systems Interconnection for CCITT Applications
	97/16 IS 8326	Session Service Definition
	97/16 IS 8327	Session Protocol Specification
	ECMA-75	Session Protocol
4	T.70	Network Independent Basic Transport Service for Telematic Services (was S.70)
	X.214	Transport Service Definition for Open Systems Interconnection for CCITT Application
	X.224	Transport Protocol Specification for Open Systems Interconnection for CCITT Applications
	97/16 IS 8072	Transport Service Definition
	97/16 IS 8073	Transport Protocol Specification
	97/16 DP 8602	Connection Oriented Protocol for Providing the Connectionless-mode Transport Services Utilizing the Connectionles-mode Network Service of the Connection-oriented Network Service
	97/16 N 1699	Layer Management in the Transport Layer
	97/16 N 1703	Addendum to the Transport Service Definition Covering Connectionless-mode Transmission
	ECMA-72	Transport Protocol
3	X.21	Interface Between Data Terminal Equipment (DTE) and Data Circuit-Terminating Equipment for Synchronous Operation on Public Data Networks
	X.70	Terminal and Transit Control Signalling System for Start-Stop Services on International Circuits Between Anisochronous Data Networks
	X.213	Service Definition of OSI for CCITT Applications
	97/6 DIS 8348	Network Service Definition
	97/6 DIS 8473	Protocol for Providing the Connectionless Network Service
	97/6 N 2916	Working Draft for an Addendum to the Network Service Definition Covering Network Layer Addressing
	97/6 N 2965	Internal Organization of the Network Layer
	97/6 N 2969	Addendum to DIS 8348 Covering Connectionless-mode Transmission

Table 19. (continued)

Layer	Document No.	Title
3/2	X.25	Interface Between Data Terminal Equipment (DTE) and Data Circuit-Termination Equipment (DCE) for Terminals
	X.32	Interface between DTE and DCE for Terminals Operating in the Packet-mode and Accessing a PSPDN through a PSTN or a CSPDN
	X.75	Terminal and Transit Call Control Procedures and Data Transfer System on International Circuits Between Packet Switched Data Networks
	97/6 DIS 8208	X.25 Packet Level Protocol for Data Terminal Equipment
2	T.71	LAPB Extended for Half Duplex Physical Level Facility
	X.212	Data Link Layer Service Definition
	ISO 4335	HDLC--Elements of Procedures
	97/6 DP 2925	Local Area Network--Link Level Control
2/1	97/6 DP 2791	Local Area Network--Token Bus Technology
	97/6 DP 2792	Local Area Network--CSMA/CD Baseband Technology
	ECMA-RR	Local Area Network--Token Ring Technology
1	V.24	List of Definitions for Interchange Circuits Between Data-Terminal Equipment and Data Circuit-Terminating Equipment
	V.25	Automatic Answering Equipment and/or Parallel Automatic Calling Equipment on the General Switched Telephone Network, Including Procedures for Disabling of Echo Control Devices for Both Manually and Automatically Established Calls
	V.25bis	Automatic Calling and/or Answering Equipment on the GSTN Using the 100 Series Interchange Circuits
	X.21	Interface Between Data Terminal Equipment (DTE) and Data Circuit-Terminating Equipment for Synchronous Operation on Public Data Network
	X.21bis	Use on Public Data Networks of Data Terminal Equipment (DTE) which is Designed for Interfacing to Synchronous V-series Modems
	X.22	Multiplex DTE/DCE Interface for User Classes 3-6
	X.211	Physical Layer Service Definition for Open Systems Interconnection for CCITT Application
	97/6 N 2598	Draft Physical Service Definition--Working Paper

An essential characteristic of these efforts is mutual cooperation. The OSI Reference Model, like the ISDN, has captured worldwide interest and is stimulating cooperative efforts. An example of this was offered above in the ISO/CCITT cooperation on the model itself. It is hoped that a joint method will be worked out between ISO and CCITT so that both models will continue to be aligned. Although the OSI Reference Model has been accepted as an international standard in ISO and an approved CCITT Recommendation, it is not static. It is generally recognized that "there is likely to be a continuing need to define extensions to it and to provide fuller descriptions of some of the concepts defined by it" (Wood, 1982). ISO 7498 contains footnotes indicating some anticipated directions of expansion.

10. THE STANDARDS WRITER

This report has presented a comprehensive view of standards endeavors, including broad views of what standards are, how they are created, who creates them nationally and internationally, why they are created, what influences them, how they differ from and are important to regulations, why they are important to world trade, and what their status is in the telecommunication and information processing industries. Three of the major conclusions are: a) national and international standards development is so important today that almost no one in the U.S. telecommunication and information processing industries can afford to ignore it, b) increasing standardization productivity in these industries is demanding more and more qualified participants, and c) useful and effective standards depend upon standards writers who work within established procedures. These conclusions bring the report full circle, because they focus on its purpose which is to provide the novice standards writer a comprehensive background for informed entry into the work, thereby increasing his or her contribution. This is the key to making the standardization process better and more productive.

This final section summarizes the views of many experienced standards writers who were asked some "What is needed?" and "How to?" questions concerning standards work. The material generally addresses international standards participation, but with few modifications it applies equally well to U.S. national standards efforts.

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10.1 The Demands of Standards Writing

Effective participation in standards writing has four basic minimal demands: time, commitment, continuity, and financial support. Lack of one of these will quickly render any effort useless; in the ideal case, all four should be fulfilled without serious constraint.

10.1.1 Time

How much professional time is required for standards work? The answer can be extrapolated from the present situation. It is estimated that only 5% of U.S. standards participants spend more than 40% of their time in actual committee work--i.e., as much as 2 weeks out of 5 away from the office. The related activities (travel, adequate preparation, on-going study and review, promotion including vertical and horizontal accountability, etc.) are often fragmented, and may or may not be included in the remaining 60% of work time. The other 95% of part-time U.S. participants use anywhere from 0 to 40% of their on-the-job time in standards work, probably averaging between 10 and 20%.

A recognized problem facing the U.S. participants in international work is that the percentage of European writers who are totally, or at least highly, involved in standards work as a career is appreciably higher than the percentage of full-time participants from the United States. In the United States, there are relatively few full-time standards workers, either in industry or in Government. Many of these are in administrative positions within the standards community or within their own companies. Consequently, the traditional European, and increasingly Japanese, approach to standards work as a full-time job challenges the "part-time" U.S. participant to be carefully prepared to express, and if necessary, defend the U.S. position. For the majority of U.S. participants, standards work, which is time intensive, is added to the responsibilities of a 40-hour work week, or is only partially included in the work responsibilities. Optimum use of the time dedicated to standards work occurs when the work is integrated with job responsibilities.

This does not suggest that large numbers of 100%-career standards professionals would solve the problems faced by the United States abroad. Rather, one potential danger associated with full-time standards writing is quickly losing sight of the practical, technically changing aspects of the technology. As stated above, some realistic work combination of the

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theoretical (standards writing) and practical (nuts and bolts experience) agreed upon in the individual's work setting seems optimal for the standards writer.

10.1.2 Commitment

The second factor demanded by standards work is commitment or dedication. This includes above all a disciplined work ethic, because standards writing is hard and demanding. Participants must be willing to travel (often tiring in itself), to keep long hours as needed, and to participate in several related committees if required.

The last factor, committee participation, can range from one committee that meets seldom, to several that meet often. The OSI studies discussed in Section 9 offer an example of the extensive commitment that might be required to pursue just one topic, the Network Layer. The following scenario is drawn from the actual experience of one active participant.

Subcommittee X3S3.3 is responsible in ASC X3 for the Network Layer. An X3S3.3 member would want to participate in X3T5.1, which has responsibility for the overall Reference Model. Since X3S3.3 and X3T5.1 are accountable to X3S3 and X3T5, respectively, the actions of these parent TCs are also important.

The related Local Area Network studies in IEEE are also of interest, and so liaison work in IEEE Project 802 and/or up-to-date information is necessary to make sure that the U.S. standards are all compatible. In addition, since X3S3.7 deals with Public Data Networks, this group's work is significant because it is important to know how the Network Layer standards and those of the Public Data Network fit together.

Internationally, ISO TC97/SC6/WG2 and ISO TC97/SC16/WG1 are the counterparts to X3S3.3 and X3T5.1, and attendance at the relevant international meetings helps to ensure that the U.S. position is clear to the international committee. Also, since CCITT Study Group VII studies telecommunications-related Reference Model Questions (Questions 23 and 27, Working Party 5), this CCITT work is of interest to the X3S3.3 member. Even if attendance at the SG VII meeting is impossible, attendance at the U.S. CCITT Study Group D meeting is important because the contributions to CCITT from the United States must be approved by this group.

The ultimate significance of such widespread participation is the desire to get it all right the first time, as far as is humanly possible. The

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process is too far reaching in its results to permit irresponsible standards development. The public review period is too late to change the essentials of a standard; on-the-spot participation in the development process is required.

10.1.3 Continuity

A prerequisite for continuity of participation is having sufficient professional time allotted to standards work and the personal (and necessarily corporate) commitment to it. Lack of continuous participation by individuals from the United States in international meetings is considered by many a major U.S. problem.

Attendance by an individual at international meetings on a non-continuous or spasmodic basis is not enough. It is easy for the work of one or even several persons from the United States to be totally undone at a meeting, if there are not experienced participants present who understand the work done in previous meetings to protect the U.S. interests.

10.1.4 Funding

Making U.S. participation possible, of course, is the financial support offered by the firm, Government agency, user's group, or other employer or interest group. The consideration of long-term rather than short-term goals, in both products and services, and the present and future importance of international standards to world trade (especially in data communications) have been intrinsic to this report. This has been so because one's understanding and evaluation of these factors contribute largely to the position of the individual or corporation toward the cost of standardization.

10.2 Who Should Write Standards?

The assurance of the four basic requirements of standards writing do not, in themselves, guarantee an effective standards worker. Because the work is always committee oriented, group dynamics dictate certain personal and social characteristics that enhance success. The professional requirements, in addition to the basic technical and logic skills, are also those of a good team player in this specialized environment.

10.2.1 Characteristics

The characteristics listed in Table 20 have been gleaned from discussions with two dozen persons highly involved in telecommunication and information processing standards work. No attempt has been made to set priorities on these characteristics, so they are arranged alphabetically.

Although no one individual is expected to possess all of the characteristics listed in Table 20, it is important that the majority of the qualities are represented within the group. Examples of characteristics whose absence would negate an international standards group's effectiveness are: goal orientation, attention to minority opinion, respect for others, diplomacy, an international perspective, and writing skills.

10.2.2 Joining a Standards Group

The newcomer to standards work, interested in becoming seriously involved, is often advised to join a committee that is little known and not highly visible to gain initial experience. For some, this experience would offer grounding and security. Others would find this unnecessary and prefer maximum action from the beginning. Since the persons in standards committees usually become closely knit, entering into the work usually means entering into an established group dynamic, unless the committee is new.

It is not what the newcomer knows initially that determines successful entry but rather performance in the group, as indicated by the qualities in Table 20. The most common mistake of the novice standards writer is taking defeats as personal attacks rather than as part of the process. Successful writers, understanding that about 75% of the process is working out politically determined problems, not technical ones, are able to detach themselves emotionally from their standards role.

Probably the most useful member of a committee is one who knows the group well, has rapport with the members, understands how the group functions, and so can recognize what precipitates problems and therefore knows how to resolve them. An understanding of the political/social environments of the various countries represented, for example, helps the writer to evaluate, early in the process, the aspects of a given standard that are open to international compromise and those that cannot be.

The chairman of a standards committee has been compared to a football coach who has the gift of recognizing the individual talents and bringing them together in such a way that the team clicks. Consequently, standards groups

Table 20. Desirable Characteristics of the U.S. Standards Writer in an International Setting
(gleaned from discussions with two dozen standards workers)

Personal	Social	Professional
A standards writer should be:	A standards writer should be:	A standards writer should have:

Accountable
Assertive
Attentive to detail
Aware of role
Creative
Dedicated
Determined
Discerning
Farsighted
Flexible
Full of stamina
Generous
Goal oriented
Insightful
Nonlegalistic
Open minded
Perceptive
Responsible
	Able to disagree without being
	  disagreeable
	Approachable
	Attentive to minority opinions
	Diplomatic
	Empathetic
	Friendly
	Good listener
	Group conscious
	Interested in what motivates
	  others
	Persuasive
	Respectful of others and their
	  opinions
	Sensitive
	Verbal
		Clear understanding of group's work
		  and goals
		Experience in the field
		Knowledge of cultural, social, and
		  political environments of non-U.S.
		  group members
		Firm position on issues and a clear
		  understanding of how far to
		  compromise
		Grasp of overall standards process,
		  including cooperative efforts with
		  other groups
		Historical perspective of task
		Identification with U.S. position
		International perspective
		Knowledge of group dynamics
		Management skills
		Marketing skills
		Negotiating skills
		Organizational skills
		Political "savvy"
		Problem-solving techniques
		Questioning mind
		Technical knowledge (broad and
		  specialized)
		Understanding of the real problems
		  associated with implementation
		Willingness to learn
		Writing skills: clarity and ability
		  to visualize format

that work together well because they can negotiate in trust and consistently work from a broad view are the most successful groups.

10.3 The Challenge

As outlined in this report, the worldwide standards community is facing a challenge of unprecedented proportions. The efficacy of the United States role in the ongoing saga of ISDN, of OSI, of Text Interchange, and the new, undreamed of topics of the 90's, depends upon both the quality of U.S. standards and the effective, united participation of U.S. representatives in the international arena. This latter participation requires clear goals, worldwide views, and the willingness to represent U.S. positions rather than individual ones for a long-term benefit. In conclusion,

> [n]ever in the history of U.S. domestic and international standardization has there been a greater need and opportunity for dynamic, perceptive, and constructive leadership. The 1980's must be a period of realistic self-assessment, cooperation, and initiative. This is the challenge of the current standards decade (Williams, 1981).

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APPENDIX A: SUMMARY OF AGREEMENT BETWEEN ISO AND IEC ON INTERNATIONAL
PRODUCT STANDARDS

(Reprinted from ISO Bulletin, Vol. 12, No. 3, 1981)

The International Product Standard

The continual development of international trade has to take into
account a growing interest in questions of safety, health, environment, con-
sumer protection, transfer of technology and other important issues. ISO
and IEC are expected to promote this development by preparing international
standards related to products.

Though aware of the necessity of meeting these requirements, the two
bodies recognize that product standardization is not an aim in itself, and
that its limits and priorities must be defined. It is, in fact, extremely
difficult to specify general criteria for the content of international
standards related to products, because the needs of different fields
require different approaches depending on the character of the product.
However, there are some general principles which can facilitate decisions, and
these principles are the subject of a statement which outlines ISO and IEC
policy in the matter.

Assessment of the Need for a Standard

The statement says that in assessing the need for proposed international
standards related to products, the following should be considered as general
principles:

- Aim and purpose of the standardization effort
- Feasibility
- Timeliness
- Priority attached to the proposal vis-à-vis the existing programme
  of work in the same area
- Any necessary liaison and cooperation with other groups/bodies
- Relevant existing standards, regulations or other documents and the
  characteristics and levels so covered, taking into consideration the
  need for technical coordination of the new project with any such
  documents
- Possibility of accepting a well-established existing document as an
  international standard with or without minor amendments

Technical Content of Product Standards

The statement then deals with the technical content of the international standard. Depending upon the character of the product, it says, the following should be considered when deciding on content:

Terms are to be defined to the extent considered essential.

Interface requirements are to be included, if appropriate, including sizes and other relevant characteristics.

Interchangeability requirements are to be included for parts for which replacement is likely to arise, including sizes.

Safety and health requirements which could form part of a governmental regulation should receive priority, and be published in a separate section, to facilitate the implementation by governments of the principle of "reference to standards."

Environmental requirements are usually covered by governmental regulations and appear only in exceptional cases in international standards, but the corresponding test methods are, where appropriate, to be standardized internationally.

Performance requirements should be considered for inclusion for some types of products as far as their intended use is concerned. Primarily those characteristics should be included which are suitable for worldwide (universal) acceptance. Where it is necessary due to differences in legislation, climate, environment, economies, social conditions, trade patterns, etc., several options may be indicated. The listing of performance data (product information) to be supplied by the manufacturer is preferable to the inclusion of performance requirements for most kinds of complex products, such as electrical consumer goods, provided corresponding test methods are defined.

Variety requirements (optimum assortment) are to be considered for inclusion, primarily with respect to commonly used components, elements, and materials.

Principle of verifiability: Only such characteristics that can be verified should be included.

Commercial requirements concerning claims, covering of expenses, etc., should not be included. Documents accompanying products can be specified, if appropriate.

Requirements concerning the duties of the user of the product with respect
   to correct treatment should not be included because they are not
   requirements in respect of the product itself. However, in some cases,
   it may be necessary to specify that the product be accompanied by some
   instructions, and the aspects to be covered by such instructions may
   be specified, if necessary.

Test methods are to be standardized to the extent necessary for the verification
   of compliance with technical requirements in international standards.
   Test methods are also essential for the verification of compliance
   with governmental requirements, declarations by manufacturers or
   suppliers concerning characteristics of their products, and for compara-
   tive testing.

Sampling is to be included if acceptance criteria are standardized for a
   product for which it is not required that each item of the product
   be tested.

Designation, marking, labelling and packaging of products are complementary
   aspects to be included wherever relevant, particularly for consumer goods.

APPENDIX B: THE FCC AND NOTICE OF INQUIRY ON THE ISDN

B.1 Summary of Issues Presented in August 1983 FCC Notice of Inquiry
                          on the ISDN

                     (Reprinted from FCC Notice of Inquiry, General Docket
                     No. 83-841, pp. A1-1 to A1-4)

        ISDN will affect U.S. service providers, equipment manufacturers, and
users. This Notice of Inquiry (NOI) has examined some of the issues which ISDN
will present. In order to facilitate discussion, we have compiled a partial
list of the issues discussed in the NOI. We do not intend to restrict comments
to these subjects, rather, we are providing this to highlight certain salient
questions with the expectation that it will provide a starting point for
discussion. Comments which pinpoint specific issues and certain concrete
recommendations are essential to the proper functioning of the proceeding.

1. ISDN planning efforts are currently underway in a number of national and international forums. Are there definable U.S. interests which are being, or could be adversely affected by ISDN? In addition, are there any ISDN developments which the Commission should be aware of that have, or could, raise issues of U.S. national security? Are the interests of U.S. service providers, equipment manufacturers, and users being represented or under-represented? How can the FCC best assist in U.S. efforts to formulate a coordinated ISDN policy and represent U.S. interests? Do the technical specifications raise policy issues? If so, what issues are involved?

2. U.S. telecommunications policy is designed to promote a competitive U.S. telecommunications system. As part of this policy, we have taken steps to eliminate barriers to market entry and taken other measures to foster a marketplace with numerous interconnected telecommunications service providers. How can the FCC continue to promote competition in an ISDN environment? Could ISDN specifications be inconsistent with U.S. telecommunications policies? How can we ensure ISDN will be compatible with our telecommunications policies and objectives? How can ISDNs be designed to accommodate the U.S. web of numerous service providers?

3. Do the international ISDN draft recommendations appear to be sufficiently flexible to accommodate the regulatory structure outlined in Computer II and the Modified Final Judgment? If not, in what areas should the FCC concentrate its efforts to assure U.S. policies are accommodated?

4. The Communications Act of 1934 created the FCC for the purpose of making available to our citizens a rapid, efficient, low-cost, nationwide and worldwide communications system. What ISDN issues must be addressed in order for the Commission to carry out this obligation? Is FCC guidance necessary or desirable? What sort of guidance should be provided? What form should this take? What should the Commissions's short-term and long-term ISDN objectives be, and how can they be achieved? The Commission has many administrative procedures available by which ISDN could be addressed. Should ISDN-related issues be considered in rulemaking proceedings and/or in ad hoc processes such as facility authorizations and tariff filings?

5. How will ISDN affect U.S. users, service providers and equipment manufacturers? How could U.S. users, service providers and equipment manufacturers benefit from ISDN? What services and benefits are unique to ISDN?

What trade-offs are involved? Could ISDN specification efforts adversely affect
users' ability to select service providers and services they wish to utilize?
How will the development of ISDN affect private networks? Will ISDN's be
designed technically and economically to accommodate existing services, such
as private lines? Would the implementation by an ISDN(s) of a substitute
service for private lines, such as permanent virtual circuits, satisfy current
private line users? Is there some reason for the U.S. to seek, as a policy
objective, the continued availability of dedicated leased channels in an ISDN
environment?

      6. ISDN specification efforts are aimed towards creating a uniform set
of worldwide technical standards. To what extent should U.S. ISDNs conform to
those standards? Are there technical, economic, or regulatory considerations
which would mandate deviation from those standards? If so, to what extent
is nonconformance possible or desirable?

B.2 Summary of Comments Received by the FCC on the Notice of Inquiry on the ISDN

    (Reprinted with permission from Telecommunications Reports, Oct. 31, 1983.)

    Comments submitted to the Federal Communications Commission last week on
a worldwide effort to set standards for integrated services digital networks urged
that draft recommendations of the International Telegraph and Telephone Consulta-
tive Committee should reflect the pro-competitive policies of the United States
in telecommunications. The Commission began an inquiry into ISDNs this past
summer, noting the need for uniform standards within and between national networks,
and seeking views on the relationship between CCITT's planning efforts and U.S.-
designated efforts. (TR, Aug. 8).

    The American Telephone & Telegraph Co. opposed an FCC investigation of
ISDN standards because it would duplicate the work of the CCITT and hurt its
efforts to develop an international model compatible with U.S. policies. AT&T
offered to work with the FCC, the State Department, and the National Telecommuni-
cations & Information Administration to develop review procedures within the Joint
Working Party to ensure that U.S. policies are thoroughly considered in CCITT
proposals. The company noted "It is in the interest of the U.S. public and
private sectors to work in a mutually cooperative fashion to develop compati-
bility, to the extent possible, between an international ISDN model and U.S.
policies."

    Although urging a strong monitoring role for the FCC and active partici-
pation in the ISDN process, most of the Bell operating companies called for
leaving standards development to the industry. The BOCs endorsed FCC partici-
pation in the CCITT, but recommended "that its role should complement existing
planning activities and not be directed to the detailed specification process."

They said that one goal of the United States in the transition to ISDN should be to retain the availability and affordability of the public telephone network by taking a stand on low-cost terminal equipment.

Filing jointly, the Mountain States Telephone and Telegraph Co., Northwestern Bell Telephone Co., and Pacific Northwest Bell Telephone Co. endorsed the bearer/ telecommunications approach suggested in the proposed ISO/OSI model, and recognized in the FCC's notice of inquiry, as consistent with the Commission's multiple vendor and pro-competitive policies. They stressed, however, that the Commission must base the rules governing ISDN for the U.S. on the domestic marketplace, and not on an internationally established model which does not reflect U.S. interests.

According to the GTE Service Corp., the implementation of ISDNs will have a beneficial impact on users, service providers, manufacturers, and national security interests. Competitive U.S. interests should handle the implementation of ISDNs, with the FCC offering minimum regulatory guidance, and any technical problems should be resolved in an open forum such as the American National Standards Institute committee, GTE said. Regarding the customer interface point, GTE urged the Commission to "keep an open mind" in determining whether its pro-competitive policies are being helped or hindered.

"Worldwide technical compatibility is the hallmark of successful international telecommunications," MCI Communications Corp. told the Commission. MCI said that "no single nation, nor any single firm within any nation, should impose its technical standard upon the telecommunications entities throughout the world." Multiple manufacturers of telecommunications equipment will benefit the public, it said, and "care should be taken lest any manufacturer, U.S. or otherwise, preempt ISDN technical standards."

The Exchange Carriers Standards Association proposed that its T-1 committee serve as an industry forum for the development of voluntary technical interconnection standards in accord with American National Standards Institute principles. ECSA suggested that the FCC and other interested agencies participate in the process either as observers or as government members.

Support for the plan came from the United Telephone System, Inc., which felt that "such an open process will provide substantial safeguards against the inherent risks of anticompetitive behavior in the standards setting process." UTS said that strong economic incentives for industry to conform to the interconnection arrangements, and a competitive domestic marketplace, would preclude any need for FCC oversight.

The Association of Data Processing Service Organizations, Inc., called on the FCC to strive for standards driven by policy rather than technology, and to encourage the CCITT to conduct a cost-benefit analysis of ISDN. ADAPSO asked the FCC to ensure that the benefits of ISDN are considered from a user, as well as a carrier perspective, and to seek standards that incorporate the basic-enhanced dichotomy of the second computer inquiry and the continued availability of flat-rate private line service.

The Independent Data Communications Manufacturers Association urged the FCC to "affirm its commitment to full competition in customer premises equipment, and put the world on notice that the "U" reference point will remain the demarcation between network functions and CPE functions in the U.S." IDCMA called on the FCC to participate more actively in the CCITT process, to monitor AT&T's role, and to "counteract it where appropriate."

The Computer and Business Equipment Manufacturers Assn. voiced concern that countries where services and equipment are provided on an end-to-end basis would not advocate the same competitive conditions existing in the United States. CBEMA basically supported flexible international standards that would take into account the Computer II decision and other U.S. policies. It also supported the option of interconnection at each of the reference points, and a careful transition to avoid stranding of investments by carriers, enhanced service providers, manufacturers, or users.

The International Communications Association recommended separate FCC proceedings on ISDN technical standards, permanent virtual circuits for leased private lines, and on competitive issues relating to the precise manner in which ISDNs will be implemented. ICA said it is unclear what roles the divested BOCs, AT&T, other interexchange carriers, and equipment manufacturers will play in ISDN development. "Assuming all of these groups plan to participate whole or in part in ISDNs, conflicts among them seem unavoidable," ICA told the Commission. It also urged the FCC to avoid ad hoc actions on tariffs or facility applications by U.S. carriers "which might undercut orderly and comprehensive ISDN policy development."

The National Telecommunications and Information Administration said "The process of negotiating functional international ISDN standards, to allow the interconnection of networks and the interoperability of equipment, can protect U.S. interests, and encourage market entry, competition, and innovation." NTIA cautioned, however, that ultimately the marketplace must be allowed to determine the success or failure of industry structures and service offerings, because only then will the public and business users get the services they need at reasonable prices. "This in turn will require far more user participation in the ongoing process of ISDN development," NTIA said.

In a letter to the FCC, the Defense Communications Agency said that the ISDN standards will have a large impact on the national security and emergency preparedness telecommunications of the United States throughout the world, and Commission involvement is needed to ensure that these needs are met.

The International Business Machines Corp. said that CCITT policies should favor competition in CPE and basic transmission services, the separation of basic and enhanced services, and unbundled provision of services carried over the signalling channel. IBM also suggested that the committee take into consideration cost-based pricing of basic services, and customer responsibility for determining interoperability of CPE. The firm endorsed the expansion of user interface, and continued user system management capability.

Greater attention to broad policy issues by the CCITT was urged by RCA Communications, Inc., which feared the adoption of ISDN technical standards without proper consideration of their effects on U.S. communications policy. "Either existing bodies should expressly address these issues, or a new body must be created," RCA advised. It also warned against the development of international standards which would foster a telecommunications monopoly in the United States.

Arguing in favor of an ISDN model that would accommodate new transmission techniques, Motorola, Inc., said it has developed a technique for "U" interface and an integrated circuit device compatible with the ISDN model. It said it "does not seek to have the Commission standardize its technique or the product which it has developed, but rather urges that the Commission not take action to preclude such system innovations."

Aeronautical Radio, Inc., suggested that the FCC continue discussions with foreign telecommunications administrations, but that it insist on the continuance of cost-based private lines. It advised a close examination of the effect of ISDN on Computer II and the AT&T antitrust settlement, and urged the FCC to collect and disseminate information about the impact of ISDN on international telecommunications.

The Communications Satellite Corp. urged the development of a "universal" ISDN to ensure the use of any combination of transmission media and to encourage intermodal competition in the global marketplace. Comsat also favored operating standards for ISDNs which continue the use of satellites as well as terrestrial facilities.

The American Satellite Co. called for "adequate representation of satellite technologies" in the development of a uniform international model for ISDN. ASC stated that "FCC involvement in ISDN planning efforts should continue and should foster U.S. policy objectives by promoting a competitive U.S. telecommunications system. However, market forces should be allowed to shape the industry as much as possible, with regulation only where necessary."

Based largely on its assumption that the setting of equal access standards will influence the direction of ISDN, Continental Telecom, Inc., said that to establish ISDN standards now would be premature. Contel described the domestic marketplace as "dynamic," and said it would adjust to any "reasonable" set of standards. "For the time being," it said, "the Commission should seek to promote its pro-competitive policies by minimizing domestic regulation of ISDN and encouraging forums to prescribe flexible ISDN technical standards. These can accommodate the needs of the domestic marketplace without unduly impinging upon the international regulatory environment."

III. CONCLUSION:

87.   In summary, we view this proceeding as having served the valuable purpose of focusing the attention of the industry and of government on the policy implications of ISDN planning. Many issues raised in our Notice and in the comments have been resolved successfully in the ISDN planning which continued during the pendency of this inquiry. Other issues have been raised which will require resolution in ISDN planning and possibly in the United States regulatory process in the future. This inquiry has served to place the affected public on notice of these, and has started the process under which these issues too may be resolved.

88.   It is clear from the comments and our analysis that the FCC has an institutional interest in the ISDN planning process, because the results may be subject to the regulatory process in the future, and because it is possible at an early stage to seek to ensure that the planning incorporates sufficient flexibility to accommodate important United States telecommunications policies. In this report, we have emphasized the strong domestic bias in favor of voluntary standardization by the private sector, not government. However, we have acknowledged that internationally a somewhat different model is pursued. Thus, while the United States probably would not impose standards on the many technical matters now being addressed in CCITT ISDN planning, a process which by virtue of the governmental provision of telecommunications in many countries is largely a governmental one, it is important that CCITT recommendations which are treated as binding by other administrations be consistent with important interests of the United States public in commerce, defense and foreign policy. For this reason, we conclude that the United States should participate effectively in the ISDN .deliberations of the CCITT.

89.   At the same time, we have sought to arrive at a role for the FCC in this process which promotes the statutory objectives of the Communications Act and the public interest generally, but without impeding the evolution of ISDN. We have concluded that the advisory committee processes of the Department of State and the processes of voluntary standardization organizations such as the ECSA/T-1 Committee provide an opportunity for the policy implications of largely technical ISDN planning judgments to be addressed. Through informal participation in these processes by the FCC and its staff, we believe that these policy issues can appropriately be resolved. And finally, while we have rejected the option of subjecting ISDN planning to the rigidities of the formal rulemaking process, we have concluded that the informal inquiry procedure used in this proceeding can be valuable as an additional forum for addressing policy issues in the future -- as circumscribed above -- and for that reason we are not terminating this inquiry.

APPENDIX C: TOWARD A POLICY ON VOLUNTARY TELECOMMUNICATION STANDARDS

C.1. OMB CIRCULAR A-119: Federal Participation in the Development and Use
     of Voluntary Standards
                         (Reprinted from the Federal Register, November 1, 1982)
C.1.1 Purpose

     This Circular establishes policy to be followed by executive agencies

in working with voluntary standards bodies. It also establishes policy to be

followed by executive branch agencies in adopting and using voluntary standards.

C.1.2 Recisions

     This Circular supersedes OMB Circular No. A-119, dated January 17, 1980,

which is rescinded.

C.1.3 Background

     Many governmental functions involve products or services that must meet

reliable standards. Many such standards, appropriate or adaptable for the

government's purposes, are available from private voluntary standards bodies.

Government participation in the standards-related activities of these voluntary

bodies provides incentives and opportunities to establish standards that serve

national needs, and the adoption of voluntary standards, whenever practicable

and appropriate, eliminates the cost to the Government of developing its own

standards. Adoption of such standards also furthers the policy of reliance

upon the private sector to supply government needs for goods and services, as

enunciated in OMB Circular No. A-76.

C.1.4 Applicability

     This circular applies to all executive agency participation in voluntary

standards activities, domestic and international, but not to activities

carried out pursuant to treaties and international standardization agreements.

C.1.5 Definitions

     As used in this circular:

     o Executive agency (hereinafter referred to as "agency") means any execu-

        tive department, independent commission, board, bureau, office, agency,

        overnment-owned or -controlled corporation or other establishment of

        the Federal Government, including regulatory commission or board.

        It does not include the legislative or judicial branches of the Federal

        Government.

o   Standard means a prescribed set of rules, conditions, or requirements
    concerned with the definition of terms; classification of components;
    delineation of procedures; specification of dimensions, materials,
    performance, design, or operations; measurement of quality and quantity
    in describing materials, products, systems, services, or practices; or
    descriptions of fit and measurement of size.

o   Voluntary standards are established generally by private sector bodies
    and are available for use by any person or organization, private or
    governmental. The term includes what are commonly referred to as
    "industry standards" as well as "consensus standards," but does not
    include professional standards of personal conduct, institutional
    codes of ethics, private standards of individual firms, or standards
    mandated by law, such as those contained in the U.S. Pharmacopeia and
    the National Formulary, as referenced in 21 U.S.C. 351.

o   Government standards include individual agency standards and specifi-
    cstions as well as Federal and Military standards and specifications.

o   Voluntary standards bodies are private sector domestic or multinational
    organizations--such as nonprofit organizations, industry associations,
    professional and technical societies, institutes, or groups, and
    recognized test laboratories--that plan, develop, establish, or coor-
    dinate voluntary standards.

o   Standards developing groups are committees, boards, or any other
    principal subdivisions of voluntary standards bodies, established by
    such bodies for the purpose of developing, revising, or reviewing
    standards, that are bound by the procedures of those bodies.

o   Adoption means the use of the latest edition of a voluntary standard
    in whole, in part, or by reference for procurement purposes and the
    inclusion of the latest edition of a voluntary standard in whole, in
    part, or by reference in regulation(s).

o   Secretary means the Secretary of Commerce or that Secretary's designee.

C.1.6 Policy

    It is the policy of the Federal Government in its procurement and regula-
tory activities to:

o   rely on voluntary standards, both domestic and international, whenever
    feasible and consistent with law and regulation pursuant to law;

o   participate in voluntary standards bodies when such participation is
     in the public interest and is compatible with agencies' missions,
     authorities, priorities, and budget resources; and

o   coordinate agency participation in voluntary standards bodies so that
     (1) the most effective use is made of agency resources and representa-
     tives; and (2) the views expressed by such representatives are in the
     public interest and, as a minimum, do not conflict with the interest
     and established views of the agencies.

C.1.7 Policy Guidelines.

In implementing the policy established by this Circular, agencies should
recognize the positive contribution of standards development and related
activities. When properly conducted, standards development can increase produc-
tivity and efficiency in industry, expand opportunities for international
trade, conserve resources, and improve health and safety. It also must be
recognized, however, that these activities, if improperly conducted, can
suppress free and fair competition, impede innovation and technical progress,
exclude safer and less expensive products, or otherwise adversely affect trade,
commerce, health, or safety. Full account shall be taken of the impact on the
economy, applicable Federal laws, policies, and national objectives, including,
for example, laws and regulations relating to antitrust, national security,
small business, product safety, environment, technology development, and
conflicts of interest. It should also be noted, however, that the provisions
of this Circular are intended for internal management purposes only and are not
intended to:

1.   create delay in the administrative process,

2.   provide new grounds for judicial review, or

3.   create legal rights enforceable against agencies or their officers.

The following policy guidelines are provided to assist and govern
implementation of the policy enunciated in paragraph 6.

o   Reliance on Voluntary Standards

     1. Voluntary standards that will serve agencies' purposes and are
     consistent with applicable laws and regulations should be adopted and
     used by Federal agencies in the interests of greater economy and
     efficiency, unless they are specifically prohibited by law from doing so.

     2.   Voluntary standards should be given preference over non-mandatory
     Government standards unless use of such voluntary standards would

adversely affect performance or cost, reduce competition, or have other significant disadvantages. Agencies responsible for developing government standards should review their existing standards at least every five years and cancel those for which an adequate and appropriate voluntary standard can be substituted.

3. In adopting and using voluntary standards, preference should be given to those based on performance criteria when such criteria may reasonably be used in lieu of design, material, or construction criteria.

4. Voluntary standards adopted by Federal agencies should be referenced, along with their dates of issuance and sources of availability, in appropriate publications, regulatory orders, and related in-house documents. Such adoption should take into account the requirements of copyright and other similar restrictions.

5. Agencies should not be inhibited, if within their statutory authorities, from developing and using government standards in the event that voluntary standards bodies cannot or do not develop a needed, acceptable standard in a timely fashion. Nor should the policy contained in this Circular be construed to commit any agency to the use of a voluntary standard which, after due consideration, is, in its opinion, inadequate, does not meet statutory criteria, or is otherwise inappropriate.

o Participation in Voluntary Standards Bodies

1. Participation by knowledgeable agency employees in the standards activities of voluntary standards bodies and standards developing groups should be actively encouraged and promoted by agency officials when consistent with the provisions of paragraph 6b.

2. Agency employees who, at Government expense, participate in standards activities of voluntary standards bodies and standards developing groups should do so as specifically authorized agency representatives.

3. Agency participation in voluntary standards bodies and standards developing groups does not, of itself, connote agency agreement with, or endorsement of, decisions reached by such bodies and groups or of standards approved and published by voluntary standards bodies.

4. Participation by agency representatives should be aimed at contributing to the development of voluntary standards that will eliminate the necessity for development or maintenance of separate Government standards.

5. Agency representatives serving as members of standards developing groups should participate actively and on a basis of equality with private sector representatives. In doing so, agency representatives should not seek to dominate such groups. Active participation is intended to include full involvement in discussions and technical debates, registering of opinions and, if selected, serving as chairpersons or in other official capacities. Agency representatives may vote, in accordance with the procedures of the voluntary standards body, at each stage of standards development, unless specifically prohibited from doing so by law or their agencies.

6. The number of individual agency participants in a given voluntary standards activity should be kept to the minimum required for effective presentation of the various program, technical, or other concerns of Federal agencies.

7. The providing of agency support to a voluntary standards activity should be limited to that which is clearly in furtherance of an agency's mission and responsibility. Normally, the total amount of Federal support should be no greater than that of all private sector participants in that activity except when it is in the direct and predominant interest of the Government to develop a standard or revision thereto and its development appears unlikely in the absence of such support.
The form of agency support, subject to legal and budgetary authority, may include:

- direct financial support; e.g., grants, sustaining memberships, and contracts;
- administrative support; e.g., travel costs, hosting of meetings, and secretarial functions;
- technical support; e.g., cooperative testing for standards evaluation and participation of agency personnel in the activities of standards developing groups; and
- joint planning with voluntary standards bodies to facilitate a coordinated effort in identifying and developing needed standards.

8. Participation by agency representatives in the policy-making process of voluntary standards bodies, in accordance with the procedures of those bodies, is encouraged--particularly in matters such as establishing priorities, developing procedures for preparing, reviewing, and approving standards, and creating standards developing groups. In order to maintain the private, nongovernment₁l nature of such bodies, however, agency representatives should refrain from decision making involvement in the internal day-to-day management of such bodies (e.g., selection of salaried officers and employees, establishment of staff salaries and administrative policies).

9. This circular does not provide guidance concerning the internal operating procedures that may be applicable to voluntary standards bodies because of their relationships to agencies under this Circular. Agencies should, however, carefully consider what laws or rules may apply in particular instance because of these relationships. For example, these relationships may involve the Federal Advisory Committee Act, as amended (5 U.S.C. App. I), or a provision of an authorizing statute for a particular agency. Agencies are best able to determine what laws and policies should govern particular relationships and to assess the extent to which competition may be enhanced and cost-effectiveness increased. Questions relating to anti-trust implications of such relationships should be addressed to the Attorney General.

C.1.8 Responsibilities

C.1.8.1 The Secretary will:

o   coordinate and foster executive branch implementation of the policy in paragraph 6 of this Circular, and may provide administrative guidance to assist agencies in implementing paragraph 8 of this Circular;

o   establish an interagency consultative mechanism to advise the Secretary and agency heads in implementing the policy contained herein. That mechanism shall provide for participation by all affected agencies and ensure that their views are considered; and

o   report to the Office of Management and Budget concerning implementation of this Circular.

C.1.8.2 The heads of agencies concerned with standards will:

o   implement the policy in paragraph 6 of this Circular in accordance with paragraph 7 within 120 days of issuance;

o   establish procedures to ensure that agency representatives partici-
pating in voluntary standards bodies and standards developing groups
will, to the extent possible, ascertain the views of the agency on
matters of paramount interest and will, as a minimum, express views
that are not inconsistent or in conflict with established agency
views;

o   endeavor, when two or more agencies participate in a given voluntary
standards body or standards developing group, to coordinate their
views on matters of paramount importance so as to present, whenever
feasible, a single, unified position;

o   cooperate with the Secretary in carrying out his responsibilities
under this Circular; and

o   consult with the Secretary, as necessary, in the development and
issuance of, internal agency procedures and guidance implementing this
Circular, and submit, in response to the request of the Secretary,
summary reports on the status of agency interaction with voluntary
standards bodies.

C.1.9   Reporting Requirements

Three years from the date of issuance of this Circular, and each third
year thereafter, the Secretary will submit to the Office of Management and
Budget a brief, summary report on the status of agency interaction with volun-
tary standards bodies.   As a minimum, the report will include the following
information:

o   the nature and extent of agency participation in the development and
utilization of voluntary standards; and

o   an evaluation of the effectiveness of the policy promulgated in
this Circular and recommendations for change.

C.1.10 Policy Review

The policy contained in this Circular shall be reviewed for effective-
ness by the Office of Management and Budget three years from the date of
issuance.

C.1.11   Inquiries

For more information concerning this Circular, contact the Office of
Management and Budget, Office of Federal Procurement Policy (202/395-7207).

David A. Stockman, Director

C.2: **National Policy on Standards for the United States**

I. INTRODUCTION

As standards are documents developed with appropriate expertise to define and/or establish acceptable solutions to recurring problems, they provide a means for effective communication in areas of science, education, technology, industry, trade, and commerce.

Standards are used to enhance engineering and manufacturing efficiencies through establishment of performance criteria, characteristics of products, procedures, methods, materials, and systems, and through interchangeability.

Where regulation is deemed necessary to safeguard the health and/or safety of product users and/or consumers, standards, which generally relate to minimum requirements, may serve as a base to further communicate understanding through descriptive terminology and procedures.

II. DEFINITIONS

1. **Standard.** A prescribed set of rules, conditions, or requirements concerning definitions of terms; classification of components; specification of materials, performance, or operations; delineation of procedures; or measurement of quantity and quality in describing materials, products, systems, services, or practices. (For convenience in the text of this policy, we refer to standards for "products, systems, and services" as being inclusive of the above.) The word "standard" does not include federal, state, or local laws or statutes enacted to adopt or reference a standard.

2. **National.** The word "national" is used in this policy in a broad sense that is inclusive of both the private and government sectors. Further, the word "national" is used to indicate that the total standards preparation resources of the U.S. constitute a national capability, a capability that is not exclusively government or private.

3. **National Standard.** A standard which has, or could reasonably be expected to have, a significant effect upon a substantial number of U.S. citizens. This term does not include what are commonly termed "company" standards, nor does it include those industry standards which have little or no significance outside of that industry. It includes standards whose acceptance is recognized on a national basis.

III. OBJECTIVE(S)

1. To provide policies with respect to both government and private initiation, development, use, and maintenance of national standards for products, systems, and services.

2. To provide a framework for the efficient organization and management of both government and private resources to ensure that the United States' national standards needs are competently and economically met, on a timely basis, under generally recognized principles of due process.

IV. SCOPE

1. **Products, Systems, and Services.** Unless otherwise excluded, this policy is applicable to all national standards for products, systems, and services found in commerce, including those acquired, fabricated, or regulated by agencies of federal, state, or local governments.

2. **Organizations and Agencies.** This policy is directed toward all organizations and agencies, government or private, that initiate, develop, or approve national standards, as well as to all government agencies that use national standards.

3. **International Standards.** Where relevant, this policy is directed toward standards participation on behalf of the United States in international as well as national standards activities.

V. GENERAL PRINCIPLES

1. **Cooperation, an Essential Element.** The national interest is best served when both the government and private sectors, and/or components of both sectors, initiate, develop, and participate in programs which stimulate and encourage cooperation of both sectors in national standards activities.

2. **National Standards Writing Activities**[1]

a. *Openness.* Participation in national standards writing activities shall be open to all persons who might reasonably be expected to be, or who indicate that they are, directly and materially affected by the activity in question. There shall be no undue financial barriers to participation. Participation shall not be conditioned upon membership in any organization including the group or organization sponsoring the activity. Organizations shall give reasonable notice of standards development activities and actions.[2]

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[1] The most commonly used method for standards development is use of a standards developing committee, but other methods which achieve a substantial degree of acceptance of the standards should also be recognized. If the standards writing activities do not have such rules and procedures as called for in this section, the product of such activities can become a recognized national standard under this policy provided that the approval of the standard is given by an organization engaged in standards approval activities and whose approval procedures are consistent with this section.

[2] One member (George Papritz) expressed the view that the first and last sentences respectively of this provision should read as follows: "Participation in national standards activities should be open to all interested persons and groups." "Organizations shall give interested persons and groups reasonable notice of standards development activities and actions."

b. *National Standards Decisions.* Decisions in national standards writing activities shall reflect a substantial agreement by all of the parties at interest, or their representatives, who are directly and materially affected by the standard. A substantial agreement means much more than a simple majority but not necessarily unanimity. It also includes the requirement to consider and attempt to resolve all substantive negative comments.

c. *Balance — Rules and Procedures.* The rules and procedures to be followed in national standards writing activities shall be such that all appropriate societal interests (e.g., government, consumer, labor, producers, users, general interests , etc.) that might be directly and materially affected by the standard in question have the opportunity for fair and equitable participation. There shall be no opportunity for domination by any single interest.

d. *Consumer/User Participation.* Special attention shall be given to ensuring that consumer/user participants are included when consideration is given to the makeup of national standards committees. Consumer/user participation should come from individuals and representatives of organized groups. For purposes of this policy, the following is applicable:

i. *User — Individual Consumer.* Where the national standards activity in question deals with a consumer product, e.g., lawn mowers, aerosol sprays, etc., an appropriate consumer participant's view is synonymous with the individual's view. In other words, consumer means an individual user — a person who uses goods and services rather than produces or sells them.

ii. *User — Industrial.* Where the national standards activity in question does not deal with a consumer product, but rather deals with an industrial product, e.g., hardness of steel, insulation used in transformers, etc., an appropriate user participant is the industrial user of the product in question.

iii. *User — Government.* Where the national standards activity in question is likely to result in a standard that may become the basis for a government action, e.g., procurement or regulation, the relevant government agency(s) participant may become one of the user participants.

iv. *User — Labor.* Where the national standards activity in question deals with subjects of special interest to the American worker, e.g., products used in the workplace, workplace environment, etc., an appropriate user participant(s) is a representative of labor.

e. *Consumer/User Views.*[3] Appropriate representative consumer/user views shall be actively sought and fully considered in national standards activities. Wherever possible, consumer/user participants with the requisite technical knowledge shall be included as active, but not necessarily the sole, consumer/user participants.

f. *Records.* Reasonable records of national standards

development activities shall be prepared, maintained, and be accessible to interested parties under reasonable conditions of time, location, and convenience to all concerned. Such records shall include, but not necessarily be limited to, the status and history of the project, reports of meetings, including discussion, disposition of dissenting views, rationale and principal supporting data for key variables and wordings, etc.

The records maintained should allow an overall review of what transpired rather than be a verbatim transcript, and need be retained for only a reasonable period of time.

3. Private Sector Commitment. The private sector shall take all necessary and reasonable steps to ensure that, to the maximum extent possible, the nation's standards needs are identified and met through the voluntary standards system.

Consistent with this commitment, those private sector organizations engaged in national standards writing activities and other beneficiaries of standards writing activities shall support and participate with the private sector standards coordinating center identified in Section VIII(2) of this policy. Such support shall include equitable fiscal support.

4. Government Encouragement. It is appropriate and essential that governments take all necessary and reasonable steps to encourage responsible private sector activities to meet national standards needs.

5. Government Participation. Government(s) should actively participate in private sector national standards activities that are consistent with this policy to lend their expertise and make their needs known to help ensure that, where necessary, and when possible, the standards developed will be in a form suitable for government use or are otherwise in the public interest.

6. Consumer/Small Business Funding. It is in the best interests of both the government and the private sectors to ensure that a reasonable source of funds is available to consumers and small businesses to support and encourage their participation in national standards activities that are consistent with this policy and to offset their costs where necessary.

7. Minimizing Duplication. In the interest of efficiency and cost-effectiveness, governments should not undertake development of new standards where suitable national standards already exist or are nearing completion unless an evaluation by government indicates that the existing standard is inadequate. Where such an evaluation indicates that changes in either the format or substance would make an existing national standard suitable for government use, the government should cooperate with the original sponsor of the standard in bringing about desirable changes.

In the same vein, private sector standards writing organizations shall take all reasonable steps to ensure that there is a minimum of duplication of effort among these organizations engaged in national standards writing activities. A principal step is full cooperation and participation with the private sector standards coordinating center identified in Section VIII(2) of this policy.

8. Effects on Innovation and Competition. Care in the development and use of standards shall be taken to ensure that they will not restrict users' choice among items that will produce satisfactory results, act as barriers to innovative designs or com-

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[3] One member (George Papritz) expressed the view that "actively sought" should be changed to "obtained" in line two. This member also believed that a new sentence, as follows, should be added at the end of the provision: "If consumers with appropriate technical knowledge are unavailable, a source of relevant unbiased technical assistance shall be made available for advice and consultation to consumer members of standards writing committees."

positions, or otherwise tend to unreasonably restrain competition and trade. In the development and use of standards, preference shall be given to those that emphasize performance and function while limiting detailed design requirements to such things as fit and interchangeability (e.g., films and cameras) and where composition or other measurable attributes cannot be expressed in terms of performance without excessive costs or undue delays for technological development.

9. **Standards Maintenance.** Any organization or agency, government or private, that initiates, develops, adopts, or uses national standards shall incorporate appropriate procedures to ensure that each such standard is reviewed at periodic intervals no longer than five years and is either reaffirmed, amended, or revoked as a result of such review. Having once published a standard, organizations or agencies shall adopt procedures such that the relevant board, committee, or council considers proposals to amend procedures or standards without unreasonable delay. Standards shall be kept current and adequately upgraded to encourage technological innovation.

10. **Forecasting and Measurement.** Organizations and agencies concerned with national standards writing activities shall encourage and support research in standards theory and methodology, especially that pertaining to forecasting and measuring various effects of standards (e.g., economic impact on commerce and consumers; quantitative changes in health, safety, and environmental factors; risk-benefit evaluation techniques; methods of ensuring equity in committee composition, etc.).

11. **Federal/State/Local Government Cooperation.** Governments, in their standards activities, should establish cooperative mechanisms to ensure that the public health, safety, and general welfare are adequately protected while at the same time minimizing undue burdens on interstate commerce. To this end, governments should take all necessary and reasonable steps to promote as much uniformity as practical in the establishment of mandatory requirements and to ensure that they are kept current.

VI. HEALTH, SAFETY, AND ENVIRONMENT

Recognizing that governments and the private sector each have an important contribution to make, it is in the national interest to have a constructive, cooperative relationship between them in the areas of public concern, e.g., health, safety, environment, energy, etc.

1. **Government Sector Role.** Government departments and agencies should take all necessary and reasonable steps to:

   a. Identify and publish their priority standards needs.

   b. Encourage, cooperate with, and actively participate in relevant national standards activities that are consistent with this policy.

   c. List all national standards that are relevant to the agencies' needs.

   d. Ensure that the following steps are taken prior to, and as a prerequisite of, any determination that a mandatory standard may be required:

      i. Technically evaluate all relevant listed standards.

      ii. Assess the marketplace for voluntary conformity with such standards.

      iii. Evaluate the suitability of such standards for use as the basis for a mandatory standard (where necessary, encourage the originating standards writing organization to revise the standard, with government cooperation, to suitable form).

      iv. Specifically consider, and make formal findings with respect to the technical, marketplace, and suitability reviews before deciding whether a mandatory standard will be required.

2. **Private Sector Role.** The private sector shall take all necessary and reasonable steps to:

   a. Identify and use all available data in determining its view of priority standards needs, as well as cooperate with governments to aid government in setting priority standards needs.

   b. Initiate and actively pursue national standards activities in a manner consistent with this policy in areas of its high priority.

   c. Cooperate with and support national standards activities that are consistent with this policy and that are designed to meet government-identified priority standards needs.

VII. GOVERNMENT PROCUREMENT

1. **Avoid Duplication.** National standards to meet government procurement needs should be developed by governments only in those instances where private sector standards development efforts are not responsive in a reasonable, efficient, and timely manner to the demonstrated government needs.

2. **Standards Preference.** National standards prepared in accordance with this policy should be given preference over other standards for use by government(s) to meet their procurement needs.

VIII. ORGANIZATION/APPEALS

1. **Centralized Government Focus.** There should be established, or identified, within the executive branch of the federal government, an entity to serve as the government standards coordinating center. It should have the principal responsibility for the coordination of government activities covered by this policy. Such a center should have a primary responsibility to:

   a. Establish criteria to determine eligibility of private sector standards activities for government support in accordance with this policy.

   b. Assist, upon request, the federal agencies in their evaluations of national standards to determine their suitability for use by the government.

   c. Cooperate with other government agencies in establishing criteria and information by which government employees with the appropriate expertise can be readily identified so as to encourage their voluntary participation in appropriate private sector standards writing groups.

   d. Serve as a catalyst to stimulate and aid federal agencies in identifying and publicizing standards priority needs.

e. Provide the guidelines for the disbursement of government funds available for financial aid to private sector standards activities to offset consumer and small business participation costs, when and as required, and for other purposes.

f. Work closely and cooperatively with the private sector standards coordinating center to ensure that the nation's standards needs are clearly identified and met in a timely fashion.

g. Establish and operate a suitable appeals mechanism as called for in VIII(3) of this policy.

2. **Centralized Private Sector Focus.**[4] There shall be established, or identified, a private sector organization to serve as the private sector standards coordinating center. This organization shall have the primary responsibility for the coordination of private sector activities covered by this policy. In carrying out these responsibilities, it shall, as a minimum:

a. Coordinate private sector standards activity and encourage conformity with this policy by private sector standards organizations writing standards for products, systems, and services identified as being national (or international) in scope.

b. Provide for meaningful participation in all of its major boards and councils by the major affected interests, including government and consumers.

c. Provide a mechanism, or mechanisms, for confirming whether or not a national standard has been prepared in accordance with this policy.

d. Having identified the need for a particular standards project, encourage qualified organizations to accept the project and move toward development of a national standard in a manner consistent with this policy as expeditiously and as effectively as possible, with due regard for the need to minimize unnecessary duplication of effort.

e. Not compete with standards writing organizations in standards development.[5]

f. Develop a broad and adequate financial base that is of such a nature that the center is reasonably independent of financial pressures of any single societal group or interest.

g. Work closely and cooperatively with the government standards coordinating center to ensure that the nation's standards needs are clearly identified and met in a timely fashion.

h. Serve as the recognized and designated representative of the United States in international, nontreaty, standards setting bodies.

3. Appeals Mechanisms

a. Both the government and the private sector standards writing activities should include realistic and identifiable appeals procedures for those interests or individuals who believe they have been, or will be, disadvantaged by the standard in question or the lack thereof, or who have a substantive disagreement with the technical content of the standard or the procedures by which it was developed.

b. The government standards coordinating center established by VIII(1) of this policy shall establish and operate a dispute resolution mechanism where interested parties can pursue disputes arising from private sector standards activities. As a prerequisite to entering the federal appeals process, the complaining party shall first exhaust his initial appeal rights within the private sector, providing such appeals processes exist and they meet generally recognized criteria of fairness and due process. If the federal process finds that the complaint has merit, the complaint, along with a complete record of the federal appeal, should be returned to the relevant standards writing organization for a timely resolution.[6]

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[4] One member (David Swankin) expressed the view that this policy statement should not recommend a centralized private sector focus because the thrust of the policy is directed toward improving the method by which private voluntary standards are produced, something that can and should be accomplished with or without an umbrella organization.

[5] One member (George Papritz) expressed the view that the following should be added to this provision: "However, the center shall develop and, if necessary, revise standards whenever it appears that this will not be accomplished expeditiously and effectively by extant private standards-making machinery."

[6] The nonvoting member (Dr. Ernest Ambler) expressed the view that any federal appeals process should deal only with questions of adherence to established procedures for the development of national standards and should not be broadened to include disputes over substantive technical decisions reached in national standards development activities.

APPENDIX D: CCITT TECHNICAL STUDY GROUPS AND CHAIRMEN FOR
THE 1985-1988 STUDY PERIOD (CCITT, 1984a)

No.	Title	Chairmen/Country
I	Definition, Operation and Quality of Service Aspects of Telegraph, Data Transmission and Telematic Services (Facsimile, Teletex, Videotex, etc.)	M. Israel Canada
II	Operation of Telephone Network and ISDN	G. Gosztony Hungary
III	General Tariff Principles Including Accounting	B. Rouxeville France
IV	Transmission Maintenance of International Lines, Circuits and Chains of Circuits; Maintenance of Automatic and Semi-automatic Networks	H. L. Marchese United States
V	Protection Against Dangers and Disturbances of Electromagnetic Origin	G. Gratta Italy
VI	Outside Plant	K. Nikolsky U.S.S.R.
VII	Data Communication Networks	J. O. Wedlake United Kingdom
VIII	Terminal Equipment for Telematic Services (Facsimile, Teletex, Videotex, etc.)	W. Staudinger Germany, FR
IX	Telegraph Networks and Terminal Equipment	M. Matsubara Japan
X	Languages and Methods for Telecommunications Applications	C. Carrelli Italy
XI	ISDN and Telephone Network Switching and Signalling	J. S. Ryan United States
XII	Transmission Performance of Telephone Networks and Terminals	P. Lorand France
XV	Transmission Systems	A. M. Nouri Saudi Arabia
XVII	Data Transmission Over the Telephone Network	K. Kern Germany, FR
XVIII	Digital Networks Including ISDN	H. K. Pfyffer Switzerland

COLLABORATION WITH OTHER INTERNATIONAL ORGANIZATIONS
ON CCITT-DEFINED TELEMATIC SERVICES[1]

(Geneva, 1980)

The CCITT,

considering

(a) that, according to Article 1 of the agreement between the United Nations and the International Telecommunication Union, the United Nations recognizes the International Telecommunication Union as the specialized agency responsible for taking such action as may be appropriate under its basic instrument for the accomplishment of the purposes set forth therein;

(b) that Article 4 of the *International Telecommunication Convention* (Malaga-Torremolinos, 1973) states that the purposes of the Union are:

"*a)* to maintain and extend international cooperation for the improvement and rational use of telecommunication of all kinds;

b) to promote the development of technical facilities and their most efficient operation with a view to improving the efficiency of telecommunication services, increasing their usefulness and making them as far as possible, generally available to the public;

c) to harmonize the actions of nations in the attainment of those ends";

(c) that Article 40 of the Convention states that "in furtherance of complete international coordination on matters affecting telecommunication, the Union shall cooperate with international organizations having related interests and activities";

(d) that this cooperation has to recognize the advisory capacity of organizations participating in the work of CCITT;

(e) that, in the study of terminals for new CCITT-defined telematic services (e.g. Teletex, Telefax, Datafax, Bureaufax, Videotex), ISO in particular is invited to give advice to CCITT based on their work on data systems and data communications;

(f) that this cooperation has to be organized in a manner that will avoid duplication of work and of decisions that would be contrary to the principles set out above,

recognizes the following principles

(1) it is the responsibility of the CCITT alone to make the decisions regarding the operational, technical (including factors needed to ensure international interworking) and tariff principles of the CCITT-defined services.

(2) while the CCITT will define many of the relevant factors for the CCITT-defined telematic services, other international organizations will be invited to give specialist advice to CCITT on subjects that are of mutual interest, such as:

- character sets and coding;
- end-to-end control procedures including error protection;
- interfaces between terminals and circuit terminating equipment;
- terminal transmitter distortion and receiver margin;
- paper sizes and text formatting.

(3) standardization, if required, of hardware and software implementation of terminals, such as printing systems, paper feed, character type fonts, paper characteristics etc., are outside the scope of CCITT.

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[1] "Telematic services" is used provisionally and include such services as Videotex, Teletex, facsimile, etc.

International Telegraph and Telephone
     Consultative Committee
         (CCITT)

VIIIth Plenary Assembly

Malaga-Torremolinos, 1984

VIIIth PLENARY ASSEMBLY - DOCUMENT 143

SOURCE: INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

TITLE: Co-operation between the CCITT and the IEC

Summary

    The growing complexity of systems, coupled with fast developments of technology require agreement on standards more rapidly than in the past. This need for acceleration is accompanied by a general scarcity of qualified manpower. The IEC suggests that by strengthening the long standing co-operation between the CCITT and IEC by means of a joint review of the respective technical programmes the necessary international standards can be developed more effectively.

Part 1: General remarks

    The digitalization of signals and the growing complexity of systems and the multiplicity of interaction between systems with different functions lead the IEC to believe that the existing links between the CCITT and itself could be strengthened to the mutual advantage of both organizations.

    This growing complexity of systems, coupled with fast developments of technology, require agreement on standards much more rapidly than in the past. In turn this acceleration of needs is accompanied by a general shortage of qualified manpower to work on the preparation of standards.

    The IEC would therefore welcome the possibility of strengthening its long standing contacts with the CCITT with the aim of reaching quicker results in establishing international standards, particularly in newly developing fields.

    The list of questions proposed by the Study Groups for the 1985-1988 period has accordingly been reviewed in the light of the activities of IEC Technical Committees and with a view to a possible strengthening of CCITT-IEC contacts. The results of this review are given in the second part of the present document.

The IEC is quite conscious of the fact that such increased co-operation at the international level would require co-operation to be intensified at the national level. Fortunately, Administrations have always been represented in IEC National Committees so that no new mechanisms require to be created.

There is a long standing tradition of cordial co-operation between the IEC and the technical organs of the ITU, dating back to the establishment in 1927 of technical collaboration with the International Consultative Committee on Long Distance Telephone Communications (abbreviated CCI), the forerunner of the CCIF.

This co-operation between the CCITT and the IEC has necessarily been circum-scribed by the responsibility of Administrations and Operating Agencies for the quality and integrity of the telecommunication systems which they operate.

The joint activity between the CCI's (CCITT and CCIR) and the IEC on Graphical Symbols started in 1960, and led 8 years later to the start of joint work on Terminology.

Telephone and telegraph transmission equipment makes use of a wide variety of electronic components etc., covered by IEC standards. In the components field alone there are more than 100 standards which apply to this area. It is suggested that, in future, the inclusion of references to IEC standards in the Annexes to Recommendations of the CCITT where this may be appropriate might be considered by the CCITT.

An important field of co-operation covers electromagnetic compatibility (EMC), where the introduction of new techniques requires not only standards relating to radio interference suppression, but also to susceptibility of equipment to unwanted signals. The interest of the CCITT in the work of the IEC in the field of EMC is well established and this work is of increasing importance.

Part II: Review of Technical Programme

When considering the list of questions proposed by the Study Groups for the 1985-1988 period there are many items where a close co-operation with IEC Technical Committees could be extremely effective as a number of the subjects included in the list have an immediate relation to subjects covered by the scopes of those IEC Technical Committees.

IEC offers to consider such items in more detail with the Chairmen of the relevant Study Groups in order to achieve the greatest possible consistency between the Study Groups of the CCITT and the Technical Committees of the IEC. Should the examination indicate that some modification of the IEC Technical Committee structure might be desired, the IEC would not exclude this possibility.

Examples of items where co-operation might be advantageous are:

- Coupling of hearing aids to telephone receivers
- Distribution cables for wideband telecommunication signals
- Characteristics and test methods of optical fibre cables
  (graded index and single mode).

Specific items of joint interest:

1. Vocabulary

JCG - Joint Co-ordinating Group on Vocabulary. The drafting work for the International Electrotechnical Vocabulary (IEV) is prepared by joint Working Groups of CCITT, CCIR, IEC and ISO. The 700 series of IEV Chapters on Telecommunications is the result of work of JCG Working Groups. So far two chapters, No. 725 on Space radiocommunications and No. 726 on Transmission lines and waveguides, have been published, and three more are being circulated for final approval.

2. Thesaurus

The late Prof. Radulet, Past President of IEC, commenced work on a Thesaurus based on terms defined by IEC, and CCITT has been invited to collaborate via the JCG.

3. Safety of equipment to be connected to public networks

In view of the many types of equipment now being connected to public networks, it is essential that basic safety standards for this equipment be developed. IEC Publications 65, 380 and 435 are widely recognized as being basic safety standards (see Appendix A). IEC is at present studying the harmonization of standards for the safety of information technology equipment as well as electrical safety of subscriber equipment connected to communication networks, and has recently initiated discussions with the CCITT, with a view to its participation.

4. Information technology equipment in general

Information technology equipment generally is dealt with by IEC TC 83 which has a role of technical coordination for all information technology standards in the IEC, and by the ITCG (Information Technology Co-ordinating Group) which among its tasks deals with relations with other organizations such as ISO, CCIR and CCITT. Among its members the ITCG has a permanent member, Prof. Cappuccini, who represents the view of the CCIR, and in order to improve relations with the CCITT, the IEC would like to propose that the CCITT nominate one person, preferably with a broad view of its activities, to represent the CCITT point of view at ITCG.

5. Communication lines

In order to accelerate the standardization work in the field of optical fibres SC 46E, which deals with the subject at present, will.be transformed into a full Technical Committee whose structure will enable to speed up the issuing of international standards in this field. This reflects the importance that the subject will have in the future.

The partition of work on optical fibres between CCITT and IEC is guided by an agreement between the organizations in Resolution 8 which is presented for approval to the 8th Plenary Assembly of the CCITT.

6. Safe functioning of systems

IEC TC 83 has decided to investigate standardization in the field of safe functioning of Information Technology Equipment (ITE) or of a system of ITE's in order to ensure that safety of persons and goods is maintained both by normal function and malfunction of the equipment.

This is again an area where IEC expects a fruitful co-operation with the CCITT and ISO.

7. Home electronic systems

Since the beginning of 1984 Working Group 1 of IEC TC 83 has been studying the integration of home electronic systems. Its task is to review functional needs and standards activity related to electronic systems used in the home, and structure an integrated approach to standards for multiple technologies in the home environment.

One item of study will be the requirement for equipment of home electronic systems to be connected to public networks and TC 83 WG 1 of the IEC is consequently following with interest the work of CCITT SG XVIII related to ISDN, particularly that related to Question A/XVIII.

8. Advisory Committee on Electronics and Telecommunications (ACET)

The Directors of both the CCIR and CCITT have a standing invitation to the meetings of this Committee, which have been honoured on several occasions. ACET is an Advisory Committee to the IEC Committee of Action dealing with overall co-ordination in the field of electronics and telecommunications.

In Annex A to this paper a list of projects is given of items at present under consideration within the IEC, which might be of interest to the CCITT. It is suggested that to avoid any duplication of work, that it be carefully studied before decisions are taken on the questions for the next Study Period of the CCITT.

Annex B contains a list of IEC Technical Committees and Sub-Committees whose work is related to that of the CCITT.

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1. General

1. Methods of measurement of disturbances on television receiving equipment due to signals in field blanking intervals — SC 12A

2. Compatibility between receivers (sound and television) and cable distribution systems — SC 12A/SC 12G

3. Technical requirements for television receivers to ensure compatibility with other equipment and systems — SC 12A

4. IEC 489: Methods of measurement for radio equipment used in the mobile services
   Part 6: Methods of measurement for signalling equipment
   Part 7: Privacy equipment — SC 12F

5. IEC 728: Cabled distribution systems primarily intended for sound and television signals operating between 30 MHz and 1 GHz — SC 12G

6. Cable distribution systems — Two way transmission

7. Cable distribution systems — Fibre optic transmission

8. Cable distribution systems — Satellite signal distribution

9. Measuring methods related to magnetic coupling of hearing aids to telephone sets — TC 29

10. IEC 318: An IEC artificial ear, of the wide band type, for the calibration of earphones used in audiometry — SC 29C

11. Optical, fibre cables: General requirements, measuring methods — SC 46E

12. Reliability and maintainability — Software aspects — TC 56

13. Sample rate and source encoding in professional digital recording — SC 60A

14. Tape for digital audio recording for professional programme exchange — SC 60A

15. Sound recording — PCM encoder-decoder systems — SC 60A

16. Video recording — SC 60B

17. Alarm systems — transmission systems — TC 79

18. Lightning protection — TC 81

19. Home electronic systems — TC 83

20. Telesoftware — TC 83

21. Videographic interfaces and interconnections — TC 83

22. Measurement methods for videographic equipment — TC 83

23.	Local area networks	TC 83
24.	Digital audio interface for professional applications	TC 84
25.	Digital audio interface for household applications	TC 84
26.	Command functions in a household entertainment system	TC 84
27.	Digital control of sound and vision systems	TC 84
28.	Interconnection of the equipment in a household video system	TC 84
29.	Use of infra-red radiation	TC 84
30.	IEC 764: Sound transmission using infra-red radiation	TC 84
31.	Symbols for use on equipment – New symbols primarily for TV receivers with videotex facilities and other newly developed features	TC 84 (SC 3C)

Safety

1.	IEC 65: Safety requirements for mains operated electronic and related apparatus for household and similar general use	SC 12B
2.	Safety aspects of optical fibre systems for telecommunications	SC 46E
3.	IEC 380: Safety of electrically energized office machines	TC 74
4.	IEC 435: Safety of data processing equipment	TC 74
5.	Safety of information technology equipment	TC 74
6.	Fibre optic laser radiation safety	TC 76
7.	Safe functioning of information technology equipment	TC 83

Electromagnetic compatibility (EMC)

1.	IEC 555: Disturbances in supply systems caused by household appliances and similar electrical equipment	TC 77
2.	Information Technology Equipment: Limits of interference and measurement methods	CISPR/B
3.	Interference caused by electronic data processors (microprocessors) in household appliances	CISPR/F
4.	Electromagnetic compatibility for industrial-process measurement and control equipment (IEC 801)	TC 65

    Part 1: General
    Part 2: Electrostatic discharge requirements
    Part 3: Radiated electromagnetic field requirements
    Part 4: Electrical fast transient requirements

International Telegraph and Telephone
      Consultative Committee
         (CCITT)

      VIIIth Plenary Assembly

   Malaga-Torremolinos, 1984

VIIIth PLENARY ASSEMBLY -- DOCUMENT 106

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SOURCE : ISO (SECRETARY-GENERAL)

TITLE : STATEMENT ON CCITT/ISO LIAISON ACTIVITY

In view of the agreements[1,2,3] of cooperation between ISO and the ITU and its organs, ISO is pleased to be able to submit this statement to the CCITT, so as to confirm the successes and benefits of working together during the Study Period just concluding, and to urge the continuance and improvements of this liaison activity.

ISO/TC 97, with its responsibility for Standardization in Information Systems (including Data Processing and Office Systems) has needed the availability of high performance and reasonably priced Telecommunication Facilities and Services. Its cooperative efforts with the CCITT in these matters began in earnest about 1960. The first issue of A.20 was approved by the CCITT/AP III in 1964, representing the modus operandi evolved during that period.

The intensity of our cooperation expanded rapidly, as high data rates, more complex modems, and packet services became technically and commercially feasible. The initial collaboration on Alphabet 5 was followed by alignment of HDLC and LAP-B, and thence alignment of the OSI - Open Systems Interconnection - Reference Model.

We have sent expert representatives from ISO/TC 97/SC 2, 6, 16, 18 to SG VII, VIII, XI, XVII, and XVIII and their WP's and Special Rapporteur and Editorial Sessions.

We have sat down together and developed mutually satisfactory texts for various Standards/Recommendations. We have exchanged technical contributions, delivered and defended by a liaison person; and we have submitted written contributions and requested comments. Each of the ISO groups has conducted its cooperation in a manner which fits its unique needs, and some of these experiences are cited below.

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[1] CCITT Recommendations A20, A21, et al.

[2] UN/ITU agreements Art 1

[3] Agreements of the ITU Convention Art 39, 40, et al.

METHODS OF CONDUCTING LIAISON

TC 97/SC 18 conducts liaison with CCITT SG VII, SG VIII and ECMA TC 29. This liaison is in areas of direct interest, where SG VIII is working on Messaging Systems and ECMA is active in text preparation and interchange.

What TC 97/SC 18 have attempted to do is to use as liaison representatives personnel who are normally active in SC 18 and the group they want to establish a rapport with. This has worked out very well for both SC 18 and the other organization.

In TC 97/SC 6/WG 3, the liaison is performed by sending technical material and by nominating experts for discussions in CCITT. The feed-back to WG 3 is not via liaison reports, but rather, by statements in meeting reports of the CCITT Rapporteurs. Time problems have not permitted to extend the liaison to scheduled Rapporteur meetings outside of WPs.

In TC 97/SC 16 they have evolved an excellent working method with CCITT. As soon as possible in a project, if they are aiming at an identical standard with CCITT, they try to establish the same base document. Successive versions of this document are then passed back and forth between rapporteur meetings, from ISO to CCITT and back again. Rapporteurs and experts from each organization are invited as liaison attendees to each other's meetings.

The results have been spectacular, due no doubt in large part to the fine, professional working relationships that are built up. The Chairman of 97/21 believes this point should be stressed, that the open cooperation depends on the joint technical work, not just on mandated commonality. The mutual professional respect that comes about through joint participation in each other's meetings is the key to the outstanding results in the above areas.

In areas where the joint working together of experts from both sides has not been achieved, as in the case of the Formal Description Techniques, there has not been the same outstanding level of success in achieving the desired harmony of the work.

SUBJECT MATTER, RESULTANT STANDARD/RECOMMENDATIONS

TC 97/SC 6/WG 3 is working with CCITT SGs VII, XVII and XVIII in the field of circuit-switching. The work concerns physical layer interface operations and Maintenance testing. It also defines together with IEC 48B the mechanical design of the interfaces to complement CCITT.

Key Recommendations are V.11, V.24, V.54, X.21, X.150 and I.431.

TC 97/SC 18 must have strong liaison with CCITT in the area of mutual responsibility. To date the results have been very positive with SG VIII picking up some of SC 18's work verbatim and including it in their documentation. Had the early drafts not been made available to CCITT, they would have risked doing parallel work, with differing results. Since SC 18 are dedicated to CCITT compatible standards as soon as possible our approach has proved to be right.

An excellent example of this cooperative and joint effort deals with ISO/TC 97/SC 18/WG 4 and CCITT/SG VII Special rapporteur on Q 5/VII (as Q 33/VII* being proposed for the next Study Period) and "ISO MOTIS Standards Development Project." (See 97/18 N 306, Att 1).

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*This is the first of 8 Questions on Message Handling.

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As a result we feel that the X.400 series recommendations and the Message Handling Standards will be aligned promptly, and that the liaison is more accurately described than in the broad generalities of A.20 and A.21.

TC 97/SC 6/WG 2 has, generally, worked on the joint development of OSI, particularly concerning the Network Layer; encouragement of CCITT to adopt OSI where appropriate; participation in the development of CCITT Recommendations on OSI; encouragement of CCITT to enhance interface and interworking recommendations so as to support the full OSI Network Service.

So far this has been exclusively connection-oriented; however, there is a new question on the possible application or development of connectionless operation for the next Study Period.

A more detailed listing of TC 97/SC 6/WG 2 liaisons:

- °Development of closely - (but not exactly-) aligned connection-oriented Network Service Definitions DIS 8348 and Rec. X.213.

- °Enhancement of Rec. X.25 to support the Connection-oriented Network Service.

- °Complete alignment of ISO/DIS with X.200 text.

- °Future enhancement of Rec. X.21 and/or development of additional Recommendations for the provision of Connection-Oriented Network Service over Circuit-switched Public Data Networks.

- °Development of an ISO standard for X.25 DTE to parallel X.25 (DIS 8208).

- °OSI approach to interconnection of networks, adopted substantially by Rec. X.300.

- °Collaboration in the development of the OSI Network Layer Addressing scheme.

TC 97/SC 21 wants to continue the liaison relationship with CCITT in the same spirit during the next period. The technical areas of greatest interest are the following:

- °Maintenance of the Reference Model, Transport and Session. This includes major work in progress such as the relationships and proper integration of the three upper layers.

- °Formal Description Techniques (FDT). In this area, SC 21 recommends that we attempt to achieve a joint standard FDT starting from the extended finite state machine language working draft being used to formally specify the Transport and Session Protocols. This would not preclude the development of other languages by either organization, but this particular language would be jointly specified. This particular project will only work if we have a joint project to finalize the language based on our Transport and Session specification experience. The Chairman of SC 21, Dick des Jardines, has invited the Chairman of SG VII, Vern MacDonald, to consider this approach.

°Virtual Terminals, including the entire area of terminal handling in an OSI environment. SC 16 has established a major reassessment of the work in virtual terminals, and therefore we have in this area at this time an excellent opportunity for CCITT and ISO to work together to define and carry out projects of joint interest.

°Presentation Service and Protocol, and Common Application Service Elements (CASE). This area includes the topics of abstract and concrete syntax of common datatypes (as in CCITT Recommendation X.409), and the semantics and abstract syntax of remote procedure calls (as in X.410).

°OSI Management topics of mutual interest such as directory management and exchange of accounting information.

During the next Study Period the Chairman of TC 97/SC 18 would like to see a greater willingness in CCITT to recognize ISO's work in the "Customers Area" and for them to accept ISO doing some of this. On ISO's part he would like to see an increase in turnaround of standards - same quality but in less time than it presently takes. He is aware of ISO/TC 97/SC 18's liaisons to CCITT but is not always as aware of CCITT liaisons to SC 18.

BROAD/GENERAL BENEFITS OF LIAISON

TC 97/SC 6/WG 3 is convinced the liaison ensures harmonized DTE design in respect to the telecommunication services. In this process it is important to highlight some design principles relevant to DTEs.

SC 16 has had major successful liaison with SG VII during the past four years. Liaison has been aimed principally at commonality of architecture and protocols for OSI.

Spectacular successes have been achieved: identical texts for the Reference Model of OSI, Transport Service and Protocol, and Session Service and Protocol. In terms of large complex documents this degree of identity is unprecedented in CCITT-ISO cooperation. In a more straightforward environment, the SpA and TC 97/SC 2 joint work on ISO 646/V.3 is also a notable success.

In recognition of the outstanding relationship with CCITT, TC 97/SC 16 passed a liaison resolution to CCITT at the Ottawa meeting in October 1983, lauding the cooperation and results we have achieved and promising our continuing cooperation in the future:

SC 16[6] notes the convergence which has been achieved in the Reference Model of OSI and in the Session and Transport Layers and pledges its continuation of the spirit of cooperation with CCITT which has led to these unprecedented achievements. (Resolution L 11).

97/6/2 also subscribes to this position.

SUGGESTIONS FOR IMPROVEMENTS

The results have been outstanding. Users and manufacturers alike confirm the benefits. But if all we need to do was to congratulate each other, we would not be writing this paper. We would reiterate the comments we uttered from the

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[4]TC 97 has recently been restructured. SC 16 work is now in SC 21 and SC 6.

floor of AP VII, with leave of the chairman. Below we list some areas for improvement.

TC 97/SC 6/WG 3 feels CCITT could improve its feedback by nomination of liaison persons for the discussions in WG 3.

TC 97/SC 6/WG 2 is concerned they have no direct liaison with all SG's (a) because we were asked by CCITT Central Secretariat to go through SG VII and (b) because of lack of manpower with SG VIII, SG XI or SG XVIII.

The Chairman of TC 97/SC 6/WG 2 is concerned that the ISDN work may not be accurately aligned with the use of OSI in ISO and SG VII, and conversely that the development of OSI may not receive adequate input to the needs and structures of ISDN Communications.

TC 97/SC 6/WG 2 notes a strong SG VII presence at its meetings. Unfortunately, the WG 2 presence at SG VII is limited and inadequate. This of course is an ISO problem, and reflects the fact that PTTs are willing to fund attendance at ISO meetings to a much greater extent than employers of delegates to ISO are prepared to fund reciprocal attendance. Nonetheless, as indicated in Section 1 above, the progress made is excellent.

Representatives from ISO/TC 97/SC 16 have sat with representatives of CCITT/SG VII to align texts of various Draft Standards and Recommendations. We ought to continue to do this and should follow up on the suggestion put forth by the Convener of 97/16/6, (Att 2) to adopt a set of mutually agreed procedures for maintenance of aligned texts.

The specific topics listed in the sections above will need a cooperative working relationship with CCITT during the next Study Period. We wish to continue and to improve our liaison, so we would like to take this opportunity to point out which of our past methods have been most effective - and should be repeated - and which need some enhancement. We would like to express some concerns so the next Period's results are even better than this:

> More Direct liaisons
> More Joint meetings
> Coordination of Positions and Contributions to ISO and CCITT at
>   National preparatory levels
> Synchronization of drafts and approvals
> Management (e.g. at Direct level) contacts and coordination increased
> More policy and Administrative steps toward more efficiency.

A cooperative attitude of Officers, Staff toward sharing common goals (vs stiff insistence on prerogatives for their own sake) is essential to effective liaison.

To summarize:

> ISO is grateful for the opportunity afforded to it during this Study
> Period to work in the midst of the CCITT experts, and appreciates the
> response of CCITT Staff and the Administrations who have participated
> in ISO meetings. It wishes to continue our cooperative activities,
> and it offers suggestions for improved effectiveness.

Att 1: TC 97/SC 18 N 306
Att 2: Letter from Convener of 97/16/6

Question : 5/VII

SOURCE   : STUDY GROUP VII (March 1984)

TITLE   : REPLY TO LIAISON STATEMENT FROM ISO/TC 97/SC 18/WG 4
            "PROCEDURES FOR TEXT INTERCHANGE"

        CCITT SG VII would like to thank ISO/TC 97/SC 18/WG 4 for their
liaison statement entitled "ISO MOTIS Standards Development Project". CCITT
fully agrees with ISO on the importance of common standards for messaging,
and will be happy to work with ISO/TC 97/SC 18/WG 4 to clarify and extend the
MHS Recommendations (X.400-series) to achieve that goal. CCITT also agrees
that the collaborative effort should begin as soon as possible, and should be
carried out on a continuing basis to evolve and maintain the resulting common
standards.

        To provide a basis within CCITT for the desired joint effort, the
MHS Rapporteur Group has drafted Question 5/VII for the 1984-1988 Study Period,
covering the maintenance and continued evolution of the MHS Recommendations.
The text of that Question, attached to this reply for reference, specifically
calls for cooperation with ISO, and includes among its topics for study the
three initial clarifications requested by ISO/TC 97/SC 18/WG 4.

        CCITT proposes that, as soon as a Rapporteur is appointed for
Question 5/VII, discussion be initiated with ISO/TC 97/SC 18/WG 4 to organize
the needed collaboration.

        NOTE: Text of Question 5/VII not included here.

Communications Standards Development
Dept. C71/B651
Research Triangle Park, NC
Ext. ((919) 543)0062

March 15th, 1984   Attachment 2

MEMORANDUM TO: J. P. Ansart   ISO Transport Rapporteur France
                A. S. Chandler   ISO Session Rapporteur England
                D. Delestre   CCITT Session Editor France
                K. G. Knightson   CCITT Transport Editor England

    SUBJECT: Alignment of ISO and CCITT Transport/Session Standards

   REFERENCE: 1.   ISO/DIS8072 & CCITT X.214, OSI - Transport Service Defi-
               nition
           2.   ISO/DIS8073 & CCITT X.224, OSI - Transport Protocol Spe-
               cification
           3.   ISO/DIS8326 & CCITT X.215, OSI - Session Service Defi-
               nition
           4.   ISO/DIS8327 & CCITT X.225, OSI - Session Protocol Spec-
               ification

Gentlemen, I am writing to request your cooperation in establishing pro-
cedures to assure that the referenced Transport and Session Standards,
which presently have identical wording in ISO and CCITT thanks to your
efforts, do not become divergent in the future.

My concern is, of course, that corrections or improvements to a stand-
ard(s) could be made by ISO without the knowledge or agreement of CCITT,
or vice versa. We all have experienced situations where, in the inter-
est of technical excellence, a group has seized the initiative and made
on-the-spot improvements to a standard. In the case of the OSI Trans-
port and Session standards such action would impact and perhaps destroy
the OSI single international standard concept. My proposal is that
joint ISO and CCITT procedures be established to keep these standards in
alignment.

The subject of alignment of the ISO/CCITT Transport and Session stand-
ards will be on the Copenhagen WG6 agenda. I propose we all think about
this situation and discuss it with our colleagues between now and the
Copenhagen meeting. My intent is that WG6 prepare a draft procedure for
keeping the standards aligned which can be circulated for comment and,
after necessary revisions, be accepted by ISO and CCITT. These proce-
dures should define an ISO/CCITT review cycle for proposed corrections,
improvements, and extensions and "stage" changes to a standard; i.e.,
all base standard changes:

   - be reviewed and accepted by both ISO and CCITT,

   - contain identical wording,

   - take effect on the same date.

To: J. P. Ansart, et al.   March 15th, 1984
SUBJECT: Alignment of ISO and CCITT Transport/Session Standards
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Such a procedure would limit the ISO/CCITT standard
differences to any "options" or enhancements that are offered by
by one organization and not accepted by the other. Both ISO and CCITT
would provide for interconnection by having the same "base standard"
capability, but allow for special options.

I would appreciate your comments on this matter.

Best regards,

                                      W. F. Emmons
                                      Convener 97/16/6
/wfe

        cc: R. desJardins   SC16 Chair   USA
            Ms. F. Schrotter   ISO SC16 Sec. ANSI USA

E.4 DRAFT RESOLUTION ON COLLABORATION WITH ISO AND IEC

CCITT

VIIIth PLENARY ASSEMBLY

Malaga-Torremolinos,
8 - 19 October 1984

SOURCE : COMMITTEE A

TITLE : DRAFT RESOLUTION ON COLLABORATION WITH ISO AND IEC

Resolution Nº ...

Collaboration with ISO and IEC

The VIIIth Plenary Assembly of the CCITT,

recalling

the purposes of the Union set forth in Article 4 of the International Convention (Nairobi, 1982) relating to the harmonization of telecommunication facilities;

recalling further

the duties of the International Telegraph and Telephone Consultative Committee (Article 11) as a permanent organ of the International Telecommunication Union;

recognizing

the common interest of ISO/IEC and CCITT in the development of information technology standards, which take full account of the needs of manufacturers, users, and those responsible for communication systems,

and noting

that harmonious development of all telecommunications networks is proceeding with the determination of Member countries to work together in the ITU;

bearing in mind

(1)   the convergence of data processing and telecommunication which affects the connection of data processing and text processing equipments to public networks, and hence the Study Programmes and Recommendations of CCITT;

(2)   but that the working methods and timing of the organizations concerned are not the same;

and further noting

(1)   increasing demands on financial and specialized professional experts in both telecommunications technology and operations as well as computer science and terminal manufacturing and testing;

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(2)   the progress made on the basis of existing procedures in the alignment of technical recommendations with ISO in areas of joint interest, thanks to the excellent spirit of cooperation which has prevailed;

(3)   the increasing cost of developing international standards;

resolves

(1)   to invite ISO and IEC to examine the CCITT Study Programme in the early stages of its studies and vice versa, in order to identify subjects where coordination seems desirable, and to so advise the Director of the CCITT;

(2)   to request the Director, after consultation with the concerned Chairmen, to reply, and to furnish any additional information as it becomes available;

(3)   that the necessary contacts with ISO and/or IEC should be at the appropriate levels; within these arrangements and in accordance with Recommendation A.20, every effort be made to identify overlapping acti··ities and arrive at respective study programmes which avoid any duplication of work;

(4)   to request the Chairmen of Study Groups in drafting replies to their questions to take into account the related programmes of work and the progress of projects in ISO and IEC; further, to cooperate with these Organizations as widely as possible and by appropriate means, in order to :

(a)   ensure that the specifications which have been jointly drawn up remain aligned;

(b)   collaborate in drawing up other specifications in fields of joint interest;

(5)   that for reasons of economy, any necessary collaborative meetings take place as far as possible in association with other meetings;

(6)   that the report concerning such coordination indicate the status of alignment and compatibility of draft texts on points of common concern, in particular identifying any subject which could be dealt with in a single organization, and cases where cross-referencing would be helpful to users of published international Standards and Recommendations;

(7)   that the CCITT consider the possibility of reviewing its Resolutions and A-series Recommendations which mention coordination with ISO and IEC, noting that ISO and IEC procedures are governed by their respective Directives, so as to establish with these organizations procedures which will serve as an official basis for the development of such cooperation;

(8)   that Administrations can contribute significantly to the coordination between CCITT and ISO/IEC by ensuring adequate coordination of national activities associated with the three organizations, and that this be brought to the attention of all Administrations;

(9)   to request the Director to bring this Resolution to the attention of the competent authorities of ISO and IEC;

(10)   to request the Director to bring this Resolution also to the attention of the CCIR.

BIBLIOGRAPHIC DATA SHEET

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Dorothy M. Cerni	
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14. SUPPLEMENTARY NOTES

15. ABSTRACT *(A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature*

Telecommunication and computer technologies are merging, stimulating such global communication projects as the Integrated Services Digital Network (ISDN) and the Open Systems Interconnection (OSI) Reference Model. The systems of standards needed to ensure worldwide success of these projects are being developed. These efforts, of unprecedented complexity, are demanding an increase in knowledgeable, dedicated standards workers.

This report offers background material on the meaning, significance, and changing nature of standards and their development, both in the United States and internationally. The importance of international standardization to U.S. industry is stressed. Building on this foundation, the ISDN and OSI standardization efforts are presented as the consequences of converging technological advances worldwide. The increased cooperation among standards organizations such as the International Organization for Standardization (ISO) and the International Telegraph and Telephone Consultative Committee (CCITT) is documented. The report concludes with a summary of responsibilities and desired characteristics of standards writers.

16. Key Words *(Alphabetical order, separated by semicolons)*
American National Standards; ANSI; CCITT; computer standards; FCC; GATT Standards Code; IEC; international standards; ISDN; ISO; OSI Reference Model; regulations; Study Group XVIII; ASC T1; TC97; telecommunication standards; voluntary standards; ASC X3.

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