APPENDIX A: ORGANIZATIONS INVOLVED IN STANDARDS MAKING PROCESSES INCLUDING NETWORK MANAGEMENT

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ACRONYMS AND ABBREVIATIONS

AC	Advisory Committee
ADP	Automatic Data Processing
AG	Advisory Group
ANSI	American National Standards Institute
ASC	Accredited Standards Committee
ASC T1	Accredited Standards Committee for Telecommunications
ASC X3	Accredited Standards Committee for Information Processing
ASD	Assistant Secretary of Defense
AT&T	American Telephone and Telegraph Company
C3I	Command, Control, Communications and Intelligence
CBEMA	Computer and Business Equipment Manufacturers Association
CCIR	International Radio Consultative Committee
CCITT	International Telegraph and Telephone Consultative Committee
CEN	European Committee for Standardization
CENELEC	European Committee for Electrotechnical Standardization
CEPT	European Conference of Posts and Telecommunications
CIA	Central Intelligence Agency
CLC	Carrier Liaison Committee
COS	Corporation for Open Systems
CSMA/CD	Carrier Sense Multiple Access/Collision Detection
DARPA	Defense Advanced Research Projects Agency
DISA	Defense Information Systems Agency
DoC	Department of Commerce
DoD	Department of Defense
DoS	Department of State
EC	European Community
ECMA	European Computers Manufacturing Association
ECSA	Exchange Carriers Standards Association
EIA	Electronic Industries Association
EMUG	European Manufacturers User's Group
ETSI	European Telecommunications Standards Institute
EWOS	European Workshop for Open Systems
FAA	Federal Aviation Administration
FCC	Federal Communications Commission
FEDSTDS	Federal Telecommunication Standards
FEMA	Federal Emergency Management Agency
FIPS	Federal Information Processing Standards
FIRMR	Federal Information Resources Management Relations
FTSC	Federal Telecommunication Standards Committee
FTSP	Federal Telecommunications Standards Program
GNMP	Government Network Management Protocol
GOSIP	Government Open Systems Interconnection Protocol

ACRONYMS AND ABBREVIATIONS (cont.)

GSA	General Services Administration
HHS	Health and Human Services
I/O	Input/Output
IA	Implementation Agreement
IAB	Internet Activities Board
IAG	Interindustry Advisory Group
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IESG	Internet Engineering Steering Group
IETF	Internet Engineering Task Force
IFIP	International Federation for Information Processing
IFRB	International Frequency Registration Board
IILC	Information Industry Liaison Committee
IRSG	Internet Research Steering Group
ISDN	Integrated Services Digital Network
ISO	International Organization for Standardization
ISSB	Information System Standards Board
ITS	Institute for Telecommunication Sciences
ITSTC	Information Technology Steering Committee
ITU	International Telecommunications Union
JROC	Jointly Required Operation Capability
JTC 1	Joint Technical Committee 1
JTC3A	Joint Tactical Command, Control, and Communications Agency
LAN	Local Area Network
MAP	Manufacturing Automation Protocol
MILSTDS	Military Standards
NASA	National Aeronautics and Space Administration
NATO	North Atlantic Treaty Organization
NCS	National Communication System
NCTL	National Computer and Telecommunications Laboratory
NIST	National Institute of Standards and Technology
NIU	North American ISDN Users
NM	Network Management
NREN	National Research and Education Network
NSA	National Security Agency
NSEP	National Security Emergency Preparedness
NSF	National Science Foundation
NTIA	National Telecommunications and Information Administration
OIW	OSI Implementors Workshop
ONA	Open Network Architecture
OSD	Office of the Secretary of Defense
OSI	Open Systems Interconnection

ACRONYMS AND ABBREVIATIONS (cont.)

OTS	Office of Technology and Standards
POSIX	Portable Operating System for Unix
RFC	Request for Comment
SC	Subcommittee
SCC	Standards Coordination Committee
SEC	Secretariat
SG	Study Group
SIG	Special Interest Group
SMC	Standards Management Committee
SPAG	Standards Promotion and Application Group
SPARC	Standards Planning and Requirements Committee
SPC	Strategic Planning Committee
SPMC	Standards Planning and Management Committee
SSC	Standards Steering Committee
SWG	Special Working Group
T1AG	T1 Advisory Group
TAG	Technical Advisory Group
TC	Technical Committee
TCIF	Telecommunications Industry Forum
TCP/IP	Transmission Control Protocol/Internet Protocol
TIA	Telecommunications Industry Association
TOP	Technical Office Protocol
U.S.	United States
USDA	United States Department of Agriculture
VA	Veterans Administration

A-1 INTRODUCTION

This appendix describes many of the standards making bodies (as they exist in 1992) and indicates their interrelationships in the standards-making process with emphasis on network management. Organizations involved with standards development are described in three categories. First are those organizations developing national standards in the United States including their relationships to the international standards organizations. The national organizations are primarily those accredited by the American National Standards Institute (ANSI). The international organizations include formal groups organized under the auspices of the United Nations and the voluntary organizations whose membership consists of standards bodies from many member nations.

Second are those organizations involved with the development of Federal and military standards. In many cases, these may be adopted from ANSI approved standards or modified to meet government requirements. Finally, we describe a recent reorganization of the European Community (EC) standards organizations formed to meet the needs of the common market countries overseas. In each case, the network management activity centers are indicated and discussed from an organizational standpoint.

The information on Standards Organizations presented here was obtained from a variety of sources. A key starting point was found in Cerni (1984) but up-dated for this Appendix, other sources include the following references: CCITT (1989), Chappell (1989), Folts (1982), Cargill (1989), and OTA (1990). In addition, many other citations in various trade journals were used but not referenced here.

A-2 U.S. AND INTERNATIONAL STANDARDS ORGANIZATIONS

Prior to 1984, the technical standards for the U.S. telephone industry were determined primarily by the American Telephone and Telegraph Company (AT&T). Today, standards-setting is a major concern throughout the world with important implications for competition in the industry. The growing internetworking of telecommunication technology and services has led to a broader scope for standard-setting because of network incompatibility problems.

United States organizations involved with national and international standards are indicated in Figure A-1. Acronyms used in this figure are defined in Table A-1. Many of these organizations are Standards Development Organizations (SDOs). Others, particularly the forums,

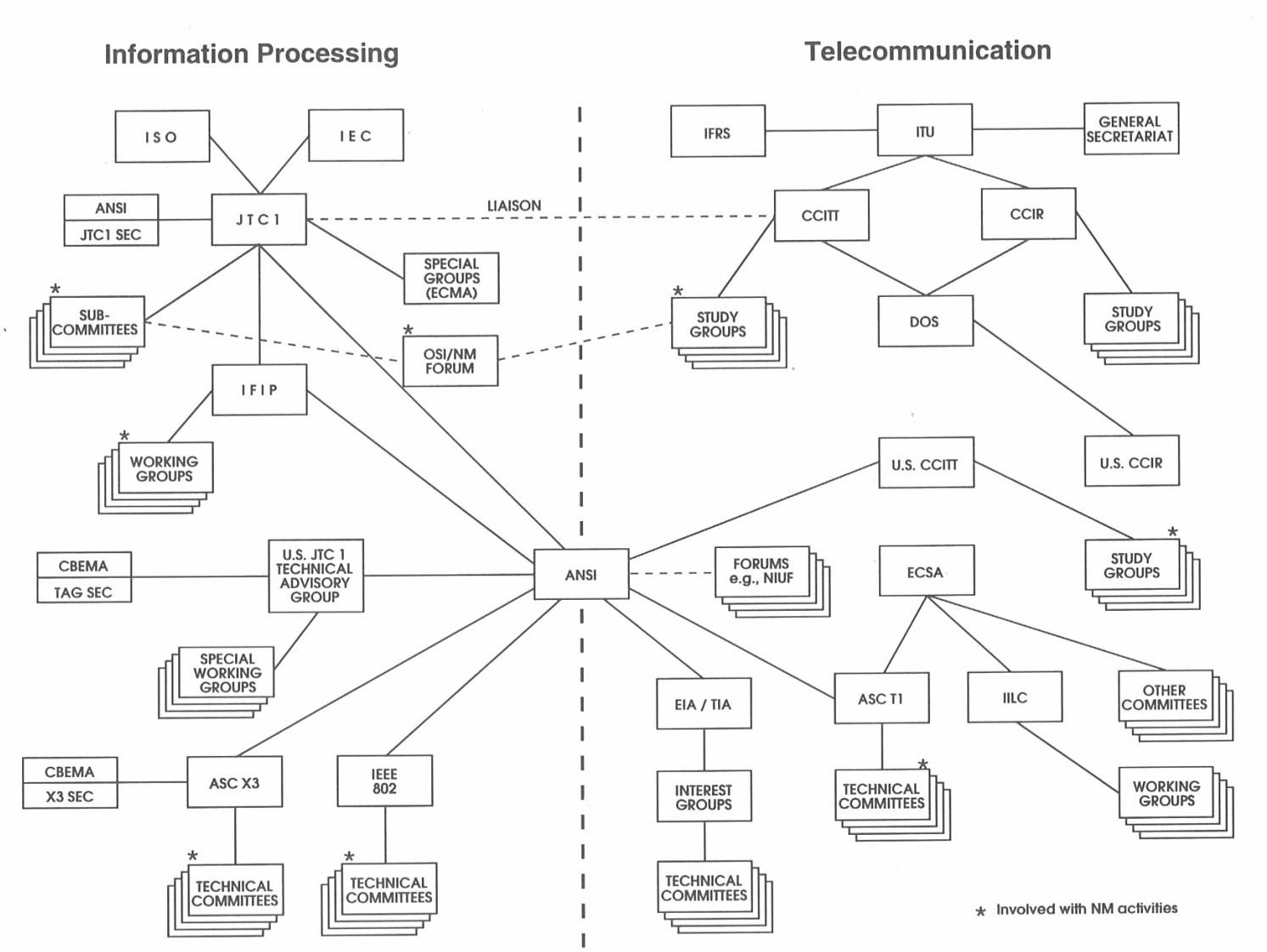


Figure A-1. National and international standards organizations.

are known as Standards Related Organizations (SROs). Actual work is done in the various working groups, study groups, and technical subcommittees in the major organizations. An asterisk here indicates that one or more of these groups is working on network management standards. These network management activities are described in Section 3.

Table A-1. Legend for Acronyms Used in Figure A-1

NATIONAL AND INTERNATIONAL ORGANIZATIONS	
ANSI	American National Standards Institute
ASC	Accredited Standards Committee
CBEMA	Computer and Business Equipment Manufacturers Association
CCIR	International Radio Consultative Committee
CCITT	International Telegraph and Telephone Consultative Committee
ECSA	Exchange Carriers Standards Association
EIA	Electronic Industries Association
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IFIP	International Federation of Information Processing
IFRB	International Frequency Registration Board
ISO	International Standards Organization
ITU	International Telecommunications Union
JTC 1	Joint Technical Committee 1
NIST	National Institute of Standards and Technology
NIU	North American ISDN Users
NM	Network Management
OSI	Open Systems Interconnection
SEC	Secretariat
TAG	Technical Advisory Group

Figure A-1 also illustrates a distinction between organizations involved with information processing and those involved with telecommunications. This distinction tends to become blurred as the two disciplines of communications and computers merge. In many cases close liaison is maintained between groups working in similar areas of standards.

With the convergence of telecommunications and information processing technologies and their markets, the companies involved have a large stake in each others standards. As

telecommunications and information processing converge, there is an increasing number of jurisdictional issues that must be resolved.

With globalization of the economy, the United States is taking a more important role in standards-setting processes. National interests may be set aside and, instead, entire world markets may be taken into account when considering what standards should be adopted by the United States in the future.

Referring to Figure A-1, the international organizations appear at the top--namely the International Telephone and Telegraph Consultative Committee, known by the French acronym CCITT, and the International Organization for Standardization (ISO). Most of the international network management activities are being conducted by various study groups in these two organizations. Open system interconnection (OSI) standards are being developed jointly by the Joint Technical Committee 1 (JTC1) of the ISO and the International Electrotechnical Commission (IEC). Most of the work on the Integrated Services Digital Network (ISDN) is being conducted by the CCITT (Bartee, 1989).

The ISO and the CCITT cooperate on many different standards. For instance, the ISDN is being developed in accordance with the OSI reference model. However, there are also important differences between the two organizations. The CCITT is a treaty organization whose decisions are binding on its signatures. The ISO is a voluntary organization that develops standards through consensus and decisions are not necessarily binding on the participants unless mandated in other ways.

The lower portion of Figure A-1 shows organizations involved in voluntary consensus standards in the United States and excludes Federal government standards and military standards that are discussed in Section A-2. We also cover the Internet standards work in Section A-2.

The U.S. voluntary standards are in most cases coordinated and approved by the American National Standards Institute. ANSI in its role in the coordination and harmonization of private sector national standards establishes procedures and guidelines for ANSI committees developing standards, such as the Accredited Standards Committees (ASC) X3, or for accredited committees established by other groups, such as Accredited Standards Committee T1. Figure A-1 shows several other organizations accredited by ANSI. The figure also indicates by an asterisk where network management activities may be conducted. For example, network management activities may be conducted in various T1 subcommittees. The national ISDN management standards are

developed by the T1M1 subcommittee, one of six subcommittees that comprise the larger T1 committee sponsored by the Exchange Carriers Standards Association (ECSA). Once the T1M1 committee agrees on a recommendation (standard), it is sent to the T1 committee. Upon T1 consensus, the recommendation is forwarded to the U.S. State Department for submission to the CCITT as an official U.S. position. Other organizations shown in Figure A-1 are discussed in the paragraphs that follow.

ANSI: American National Standards Institute

1430 Broadway
New York, NY 10018

The organizational structure of ANSI is shown in Figure A-2. ANSI is a nongovernment, nonprofit organization and serves as the United States member of the International Organization for Standardization. Most of the ANSI work is parallel to and supportive of the ISO activities. Wherever possible, ANSI tries to adopt directly the ISO Standard rather than develop its own. Because this has not always been the case, many ANSI standards are editorially different, if not sometimes technically different from ISO's standard, taking into account the unique situations in North America.

ANSI membership consists of approximately 220 nonprofit organizational members and almost 1000 company members representing virtually every facet of commerce, trade, and industry. It is governed by a board of directors, and most of its work is carried out under the direction of various councils. An extremely wide range of standards is developed and adopted on a consensus basis within the elaborate infrastructures of accredited committees.

Two accredited standards committees operate under the procedures of ANSI that are directly related to digital communication standards: X3 (Information Processing Systems) and T1 (Telecommunications). Committee T1 deals with telecommunications networks and their end-user interfaces with secretarial support from the Exchange Carriers Standards Association. Committee X3 is a large and complex organization dealing with a wide range of information-processing systems matters, with secretarial support provided by the Computer and Business Equipment Manufacturers Association (CBEMA). The IEEE and EIA also are accredited by ANSI.

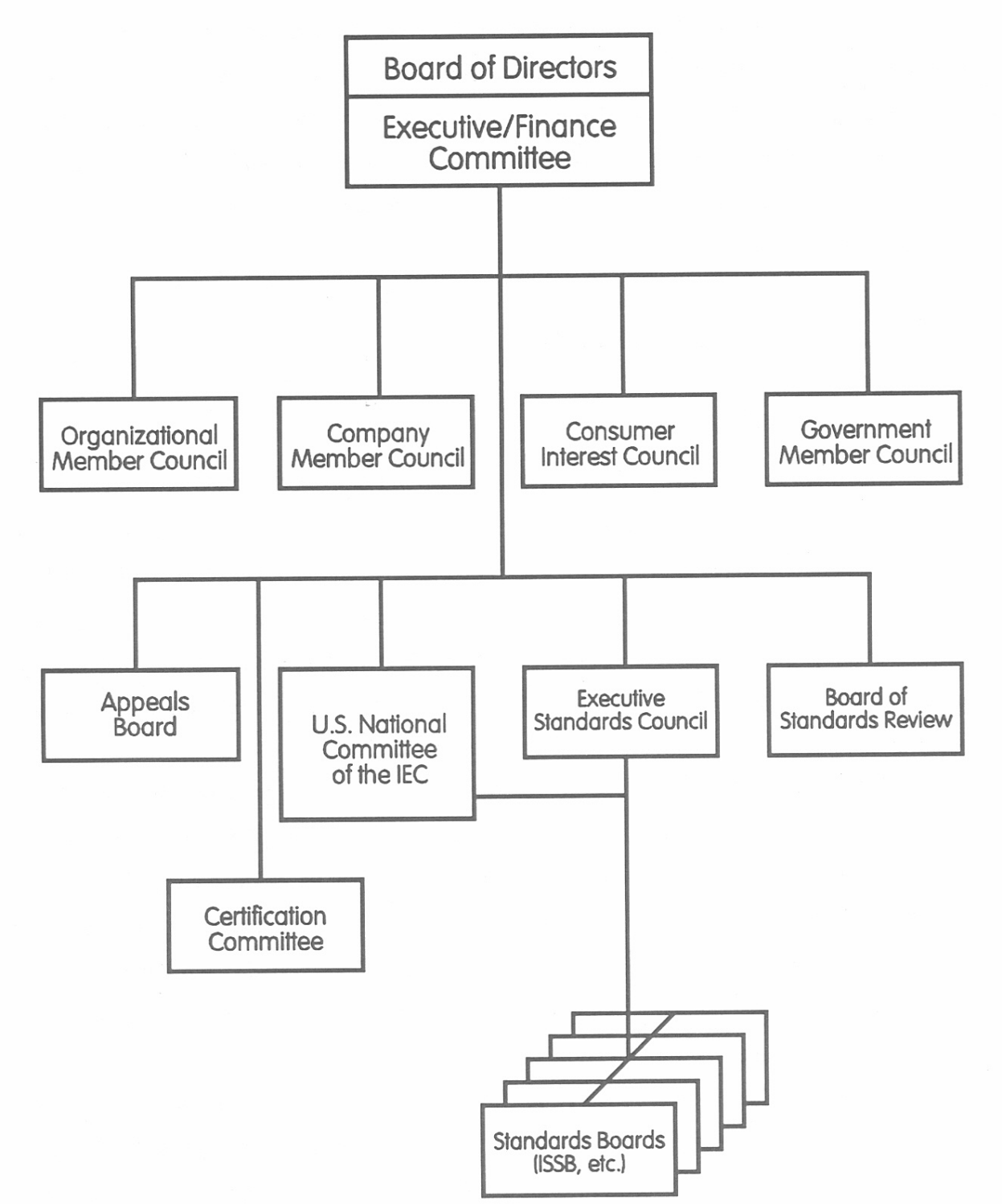


Figure A-2. Organization of the ANSI.

ASC T1: Accredited Standards Committee for Telecommunications

Exchange Carriers Standards Association
c/o T1 Secretariat
5430 Grosvenor Lane, Suite 200
Bethesda, Maryland 20814-2122

The organizational structure of T1 is shown in Figure A-3. This committee, established in 1984, is sponsored by the Exchange Carriers Standards Association, a U.S. trade organization of common carriers and suppliers. The T1 is an ANSI-accredited standards body that is developing telecommunication standards and technical reports. The standards and reports are intended to support interconnection and interoperability of telecommunications networks at interfaces with end-user systems, carriers, information and enhanced-service providers, and customer premises equipment.

Six T1 technical subcommittees (in 1992) are developing these standards and reports under the T1 Advisory Group. The subcommittees also recommend positions on matters under consideration by other North American and international standards bodies. T1 membership and full participation are available to all interested parties. The overall organization of T1 is in shown Figure A-3. Subcommittees titles are given in Table A-2.

The ASC T1 cooperates with many other groups. Liaisons include EIA, X3, ECSA, U.S. CCITT, FCC, ETSI, ANSI, and IEEE. Standards activities on network management by various T1 subcommittees are covered in Section 3 of the report.

ASC X3: Accredited Standards Committee for Information Processing

CBEMA c/o X3 Secretariat
311 First Street, NW, Suite 500
Washington, DC 20001-2178

The organizational structure of X3 is shown in Figure A-4. This committee, established in 1961, is an ANSI-accredited standards body that develops national and international standards in the areas of computers, information processing systems, and office systems. X3 also participates in the development of international standards in these areas. In addition, it serves as a Technical Advisory Group (TAG) to ANSI for most of the subcommittees working on

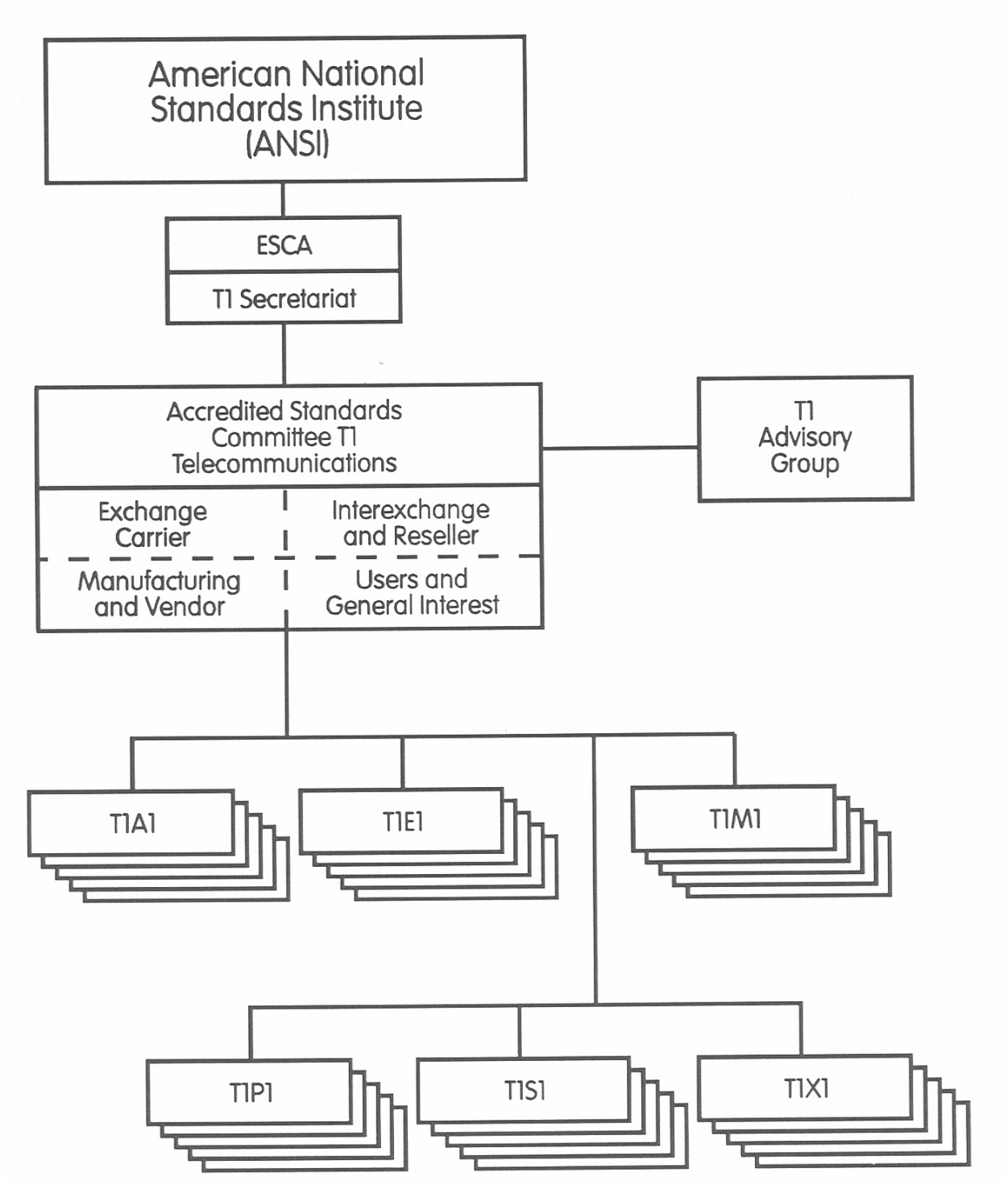


Figure A-3. Organization of the ASC-T1.

Table A-2. Technical Subcommittees of T1 and Their Working Groups

T1A1	Performance and Signal Processing
T1A1.1	Network Performance for Voice and Voiceband Data
T1A1.2	Network Survivability Performance
T1A1.3	Packet Data and ISDN Performance
T1A1.4	Digital Dedicated and Circuit Switched Performance
T1A1.5	Audiovisual Communications Coding and Performance
T1A1.6	Specialized Signal Processing
T1E1	Network Interfaces
T1E1.1	Analog Access
T1E1.2	Wideband Access
T1E1.3	Connectors and Wiring Arrangements
T1E1.4	DSL Access
T1M1	Internetwork Operations, Administration, Maintenance, and Provisioning
T1M1.1	Internetwork Planning and Engineering
T1M1.2	Internetwork Operations
T1M1.3	Testing and Operations Protocols
T1M1.5	OAM&P Architectures, Interfaces and Protocols
T1P1	Systems Engineering, Standards Planning and Program Management
T1P1.1	Program Management
T1P1.2	Wireless Access
T1P1.3	Network and Services
T1S1	Services, Architecture and Signaling
T1S1.1	Architecture and Services
T1S1.2	Switching and Signaling Protocols
T1S1.3	Common Channel Signaling
T1S1.5	Broadband ISDN
T1X1	Digital Hierarchy and Synchronization
T1X1.3	Synchronization Interfaces
T1X1.4	Metallic Hierarchical Interfaces
T1X1.5	Optical Hierarchical Interfaces
T1X1.6	Tributary Analysis Interfaces

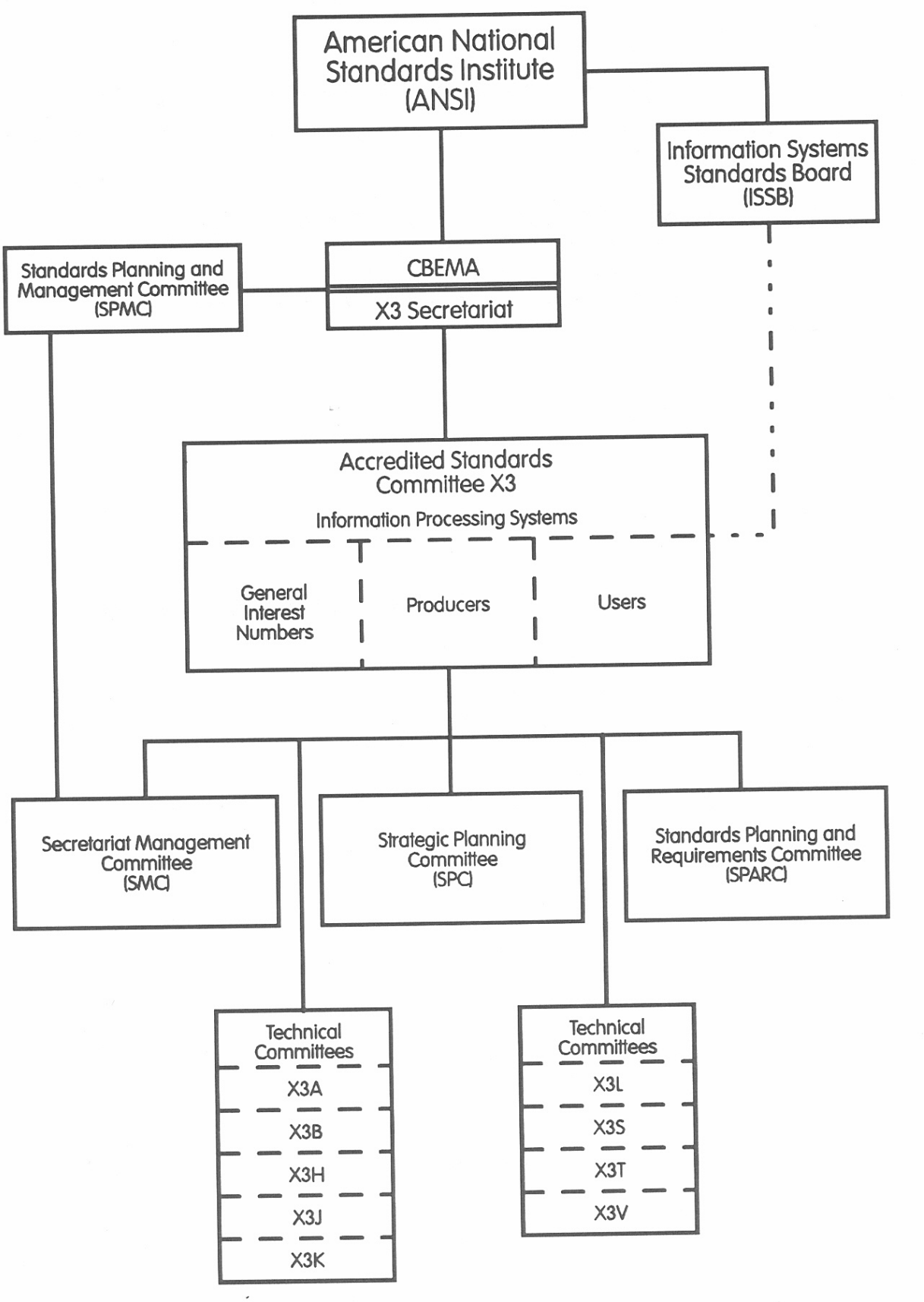


Figure A-4. Organization of the ASC-X3.

international standardization projects with the ISO and IEC Joint Technical Committee 1 (JTC 1). The CBEMA functions as X3's secretariat.

X3 membership is open to all organizations, upon payment of a service fee. The membership (in 1992) includes computer manufacturers, communications carriers, user groups, and government agencies. More than 3200 volunteers from these organizations participate in the X3 standards work. They are organized into about 85 technical groups, working on 700 projects (Moad, 1990).

The work of X3--the development of standards for the information technology industry--occurs in the technical committees (TCs). A technical committee is established by X3 to work only on projects within its assigned area of expertise. Membership in a TC is based on the single qualification that a member must be directly and materially affected by the activity and be willing and able to participate actively. TCs, which are advisory to X3, produce draft proposed American National Standards (dpANS) and defend and interpret their work as necessary. Among the more well-known X3 standards, either published or under development, are the X3J11 standard for the C-programming language and the X3J6 for windowing interfaces. Each TC has a chairperson, a vice chair, a secretary, an International Representative (the liaison with the appropriate ISO/IEC JTC 1 Subcommittees), and a Vocabulary Representative (the liaison with the TC for Information Processing Systems Vocabulary). The details of the duties of these officers, along with the requirements for these positions, are all defined by X3.

Seven main categories of technical committees cover the broad spectrum of the information technology industry. Each main subcommittee has one or more subordinate committees assigned to it. A listing of the technical committees and their subcommittees is given in Table A-3.

The focal point for digital communication activities in X3 is the subgroup on communication, Technical Committee X3S3, which generally meets concurrently with the Electronic Industries Association (EIA) Technical Committee on Data Transmission Systems and Equipment, TR-30. American National Standards Committee X3T5 (Open Systems Interconnection) and X3T9 (I/O Interface) also deal with communication-related issues.

Committee X3 and its various task groups serve as clearing houses for information brought to the meetings by liaisons from virtually all other relevant international and domestic groups, as well as a mechanism for directly effecting USA participation in ISO Joint Technical

Table A-3. Technical Subcommittees of X3 and Their Working Groups

X3A	Recognition	
	X3A1	OCR
X3B	Media	
	X3B5	Digital Magnetic Tape
	X3B6	Instrumentation Tape
	X3B7	Magnetic Disks
	X3B8	Flexible Disk Cartridges
	X3B9	Paper Forms/Layouts
	X3B10	Credit/ID Cards
	X3B11	Optical Digital Data Disks
X3H&J	Languages	
	X3H2	Data Base
	X3H3	Computer Graphics
	X3H4	Information Resource and Dictionary
	X3J1	PL/1
	X3J2	BASIC
	X3J3	FORTRAN
	X3J4	COBOL
	X3J9	PASCAL
	X3J10	APL
	X3J11	C Language
	X3J12	DIBOL
	X3J13	COMMON LISP
X3K	Documentation	
	X3K1	Computer Documentation
	X3K5	Vocabulary for Information Processing Standards
X3L	Data Representation	
	X3L2	Codes and Character Sets
	X3L5	Labels and File Structure
	X3L8	Data Representation
X3S	Communication	
	X3S3	Data Communications
X3T&V	Systems Technology	
	X3T1	Data Encryption
	X3T2	Data Interchange
	X3T5	Open Systems Interconnection
	X3T9	I/O Interface
	X3V1	Text: Office & Publishing Systems

Committee 1, and indirectly in the CCITT. Committee X3 performs these functions through the preparation of contributions and position papers adopted by consensus, with extensive use of balloting by mail.

CBEMA: Computer and Business Equipment Manufacturers Association

311 First Street, NW, Suite 500
Washington, DC 20001-2178

CBEMA is a trade organization whose primary function is to represent large manufacturers of hardware-based information technologies equipment in lobbying about public policy. In addition, it provides education programs, information exchange forums, and deals with the industry's public image. It serves as the secretariat for X3 and also offers a standards and technology program where its members can exchange information on standards issues and industry standards.

CBEMA's members are mostly large manufacturers because its dues are tied to corporate revenues and structured in a way that makes it too expensive for small companies to join. Members are either American companies or U.S. subsidiaries of non-American companies.

CCIR: International Radio Consultative Committee

Place de Nations
CH-1211, Geneva 20 Switzerland

The International Radio Consultative Committee (CCIR) is one of the two consultative committees of the International Telecommunications Union (ITU). The International Telegraph and Telephone Consultative Committee is the other. Both of these committees are permanent organs of the ITU, which is one of the standing committees of the United Nations.

All of the member countries of the ITV as well as certain private organizations can participate in the work of the CCIR. The work of the CCIR provides the basis for decisions that lead to efficient use of the spectrum for telecommunication applications. The reports and standards called recommendations by the CCIR are used by radio conferences to establish technical criteria that are the basis for spectrum allocations decisions and spectrum use on a

global and regional basis. Therefore, it is important to the U.S. that CCIR documents accurately reflect the U.S. position.

Within the U.S., the organization of the work in support of CCIR activities is under the purview of the Department of State (DoS). A National Committee chaired by DoS personnel oversees the U.S. contributions to the CCIR.

The CCIR is organized into Study Groups (SGs). Each SG addresses a specific area of radio system technology. Study Groups for the 1991-94 Study Period are listed in Table A-4. Study Group 12 on Sharing is a new group that has just been added to consider ways to make more efficient use of the spectrum by allowing different radio services to share the same frequency band. The particular topics treated by each SG should be expected to evolve to meet the needs of the times and to reflect the topics.

Table A-4. CCIR Study Groups (1991-94 Study Period)

SG1	Frequency Management and Monitoring
SG4	Fixed Satellite Service
SG5	Propagation in Non-Ionized Media
SG6	Propagation in Ionized Media
SG7	Standard Frequencies & Time Signals
SG8	Mobile Services
SG9	Fixed Service Using Radio-Relay Systems
SG10	Broadcasting Service (Sound)
SG11	Broadcasting Service (Television)
SG12	Sharing Between Services
CMTT	(Joint with CCITT) Transmission of Sound Broadcasting and Television Signals Over Long Distances
CMV	Vocabulary

The CCIR has a four-year cycle of activity, centered about the Plenary Assembly which meets every four years. Modifications to CCIR documents, created by the SGs, are approved in the Plenary Assembly. In preparation for the Plenary Assembly, the CCIR meets at an Interim Meeting about 2 years before the Plenary Assembly and a Final Meeting for the SGs shortly before a Plenary meeting.

CCITT: International Telegraph and Telephone Consultative Committee

Place de Nations CH-1211
Geneva 20, Switzerland

The International Telegraph and Telephone Consultative Committee is chartered by the International Telecommunications Union "to study and issue Recommendations on technical, operating, and tariff questions relating to telegraphy and telephony." Recommendations developed and approved by the CCITT are equivalent to Standards developed by other organizations.

The CCITT holds a Plenary Assembly every four years. The assembly approves a list of technical subjects, or "Questions" as they are called, that relate to the study of telecommunication problems and that should lead to improvements in telegraph and telephone services, with particular attention paid to international improvements. The Questions are then studied by the appropriate Study Groups, which are composed of experts from participating nations. At the following Plenary Assembly, the results of the work are presented in the form of Recommendations for approval. A new set of Questions is then also approved for the next four-year study period, in order to continue the effort to meet new requirements and advancing technology. The technical CCITT study groups are listed in Table A-5. Groups involved in network management activities are also shown in this table.

The approved Recommendations of each four-year study period are published in a series called fascicles that are identified by the color of their covers. The results from the IXth Plenary Assembly were published in 1989 in a series known as the "Blue" books.

DoS: Department of State

Eye Street, NW
Washington, DC 20520

The DoS is responsible for developing U.S. policy and voting positions accordingly on all matters of the ITU. To carry out this task the DoS uses the expertise of Committees such as the U.S. CCITT and the U.S. CCIR which are headed by the Office of International Communications Policy in the department. No organization figure is included.

Table A-5. CCITT Study Groups (1989-92 Study Period)

Group Number	Title
*Study Group I	Definition and Operational Aspects of Telegraph and Telematic Services (facsimile, teletex, videotex, etc.)
*Study Group II	Telephone Operation and Quality of Service
Study Group III	General Tariff Principles
*Study Group IV	Transmission Maintenance of International Lines, Circuits, and Chains of Circuits; Maintenance of Automatic and Semiautomatic Networks
Study Group V	Protection Against Dangers and Disturbances of Electromagnetic Origin
Study Group VI	Protection and Specifications of Cable Sheaths and Poles
*Study Group VII	Data Communication Networks
Study Group VIII (and XIV)	Terminal Equipment for Telematic Services (facsimile, teletex, videotex, etc.)
Study Group IX (and X)	Telegraph Networks and Terminal Equipment
*Study Group XI	Telephone Switching and Signaling
Study Group XII	Telephone Transmission Performance and Local Telephone Networks
Study Group XV	Transmission Systems
Study Group XVI	Telephone Circuits
*Study Group XVII	Data Communication Over the Telephone Network
*Study Group XVIII	Digital Networks Including ISDN

*Includes Network Management Activities

ECMA: European Computers Manufacturing Association

114 Rue du Rhone
1204 Geneva, Switzerland

The ECMA represents interests of computer manufacturers in Europe and works closely with many of the committees of both the ISO and the CCITT. Many U.S. corporations are represented in the ECMA via these European branches. Despite its name, this Geneva-based technical group does more work in setting international standards than other work as a trade organization for its equipment makers. ECMA standards often become the basis for ISO and IEC information-processing standards.

Forty-six companies in two classes of membership actively participate (in 1992) in the ECMA work. There include 30 ordinary members who manufacture and market data processing equipment in Europe and 16 associate members who have an interest in European area matters and in a specific subject of one or more of the ECMA Technical Committees. The associate members have the status of observers and cannot vote.

ECSA: Exchange Carriers Standards Organization

5430 Grosvenor Lane
Bethesda, MD 20841-2122

The ECSA was organized following the divestiture of AT&T in 1984 because of the need to carry out national network integration functions. The focal point in ECSA for network standards is the committee on communication (T1). Its many working groups constantly are meeting throughout the USA to develop standards that directly or indirectly affect digital communication networks. Its first standards are now in the process of adoption. This subcommittee also is accredited with the American National Standards Institute. As the awareness and extent of ISDN studies increased, the T1D1 committee, created in early 1984, became the focal point for developing common ISDN standards and CCITT-related contributions in the USA. Subsequently, that work shifted to the T1S1 committee, formed in early 1988.

ECSA also has created additional committees to consider network operations issues and provides forums for the discussion of standards and performance matters. The ECSA organizational structure is shown in Figure A-5. The major committees and forums sponsored by ECSA committee T1 and the Information Industry Liaison Committee (IILC) are described elsewhere. The Carrier Liaison Committee (CLC) coordinates and resolves national issues related to provision of exchange access. The Telecommunications Industry Forum (TCIF) was created to respond to the need for voluntary guidelines to facilitate the use of new technologies such as electronic data exchange and bar coding.

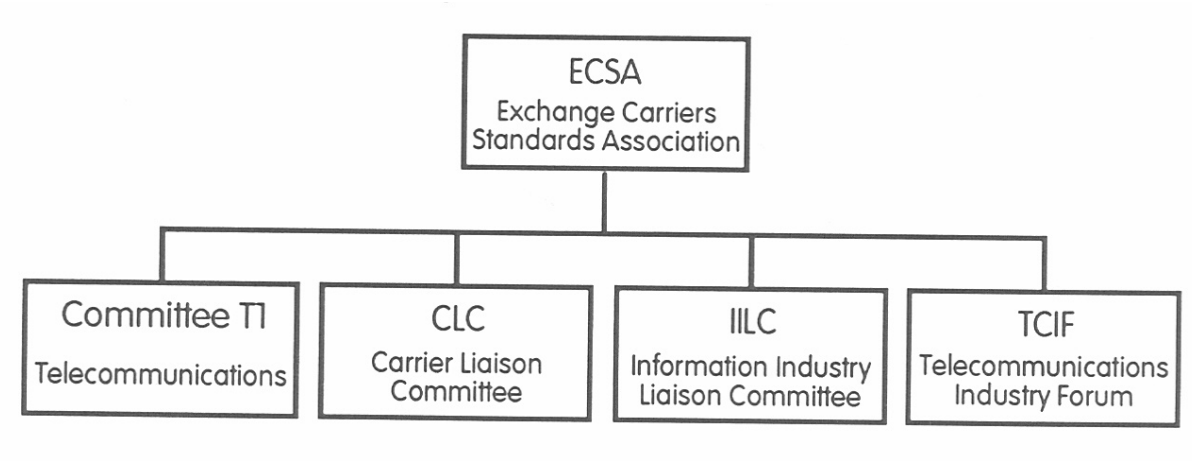


Figure A-5. Organization of the ECSA.

EIA: Electronic Industries Association

2001 Eye Street, NW
Washington, DC 20006

Organizational structure of the EIA is shown in Figure A-6. The EIA is a U.S. trade organization with ANSI accreditation and operating under ANSI rules of consensus. The EIA represents a number of manufacturers with over four thousand representatives from industry, including the radio industry. Five major interest groups conduct the standards work. The Information and Telecommunications Technology Group (ITTG) being the most relevant here.

The ITTG consist of five divisions: Fiber Optics, Mobile Communications, Network Equipment, and Users Premises Equipment. Standards are developed in Technical Committees

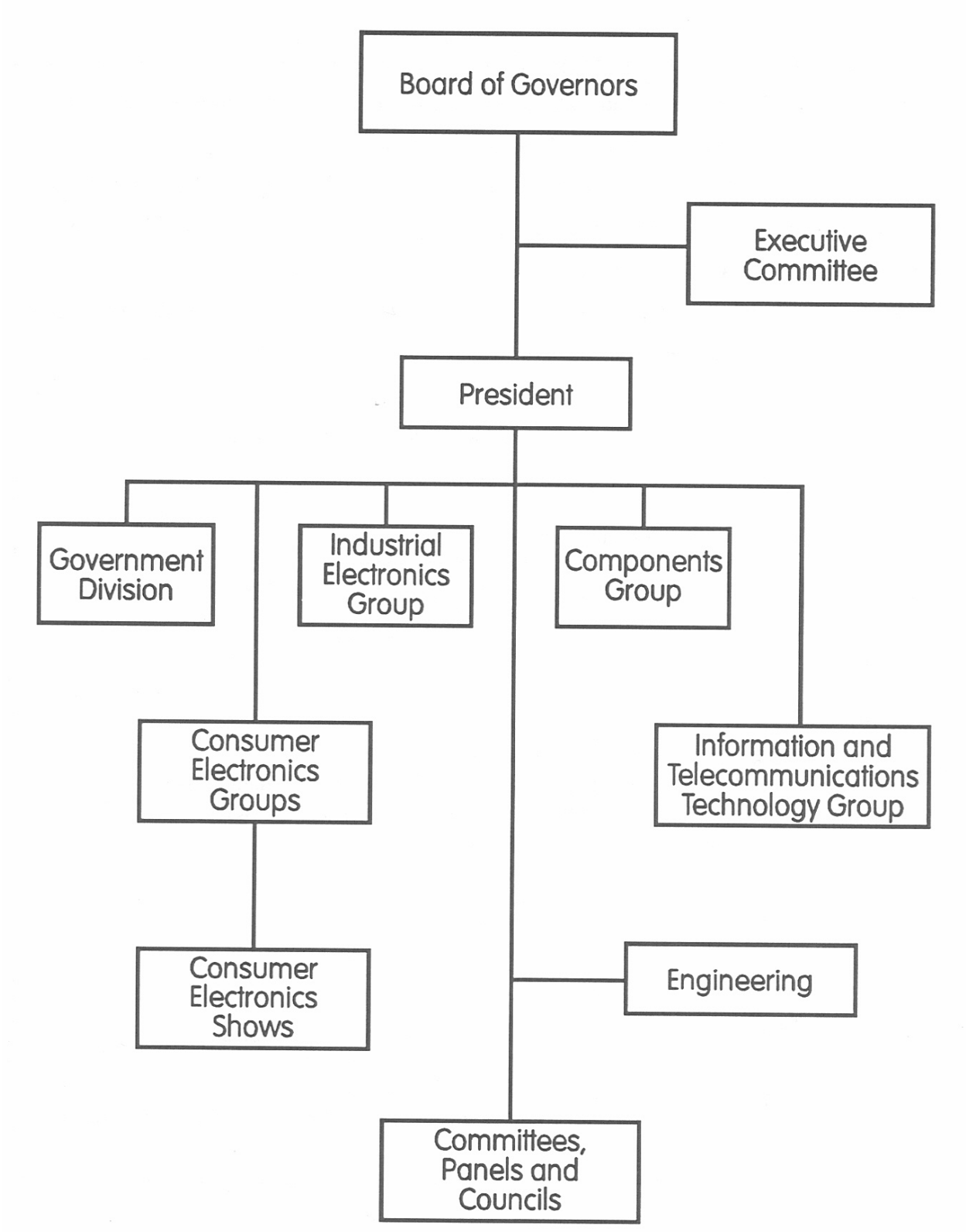


Figure A-6. Organization of the EIA.

and their subcommittees that work in specific areas. EIA standards are forwarded to ANSI for review and acceptance as American National Standards. The ITTG committees concerned with information and telecommunications technologies are listed in Table A-6.

In the comprehensive standards program, over 400 standards and publications have been produced by more than 4000 industry and government participants in some 225 committees. The EIA is also an ANSI Accredited Standards Organization, and the EIA committees contribute to the international standards work of the ISO, CCITT, and the IEC. Their most famous standard is the RS-232-C physical interface standard, which is used widely around the world.

Table A-6. Technical Committees of the ITTG

TR-29 Facsimile	
TR-30 Data Transmission Systems and Equipment	
TR-30.2	Data Transmission Interfaces
TR-30.3	Data Interfaces to Leased Lines and Dial Network
MWP	Modem Working Party
	Ad-hoc Group on Problems of Digital Transmission
TR-41 Telephone Terminals	
TR-41.1	PBX and Primary Rate
TR-41.2	Key Telephone and Basic Rate
TR-41.3	Telephone and Acoustical Transfer Characteristics
TR-41.4	Network Connection Termination Equipment
TR-41.5	Auxiliary Equipment and TDD
TR-41.6	Editorial and Glossary
TR-41.7	Safety and Environmental
TR-41.8	Building Wiring
TR-41.X	Part 68 Measurement Guidelines
FO-2 Optical Communication	
FO-2.1	Optical-Fiber Telecommunication Systems
FO-2.2	Fiber-Optic Local Area Networks
FO-2.3	Nonguided Optical Communications
FO-2.4	Optical Systems Terms, Definitions, and Document Control and Safety

IEC: International Electrotechnical Commission

3 Rue de Varembe, CH-1211
Geneva 20, Switzerland

Organizational structure of the IEC is shown in Figure A-7. The IEC is the equivalent of ISO, but deals with electrotechnical standards. Founded in 1906, this international standards organization has a membership comprising 43 countries that produce over 95 percent of the world's electric energy. It develops standards covering the entire field of electrotechnology, including electric power apparatus, electronics, appliances, radio communications, and transportation equipment. The IEC technical committees and subcommittees related to telecommunication are listed in Table A-7.

The ISO and IEC have converged certain aspects of their work in a joint technical committee to develop international standards dealing with information technology systems and equipment. This joint committee known as the Joint Technical Committee 1 is described in a subsequent paragraph. It is here that much of the international work relating to network management protocols is being accomplished.

IEEE: Institute of Electrical and Electronic Engineers

324 East 47th Street
New York, NY 10017

Organizational structure of the IEEE is shown in Figure A-8. The IEEE is a professional scientific, engineering, and educational society that develops and publishes standards and specifications in a variety of computer and engineering areas. The standards and specifications published are of three types; standards, recommended practices, and guides.

Standards are specifications with mandatory requirements. Recommended practices are specifications of procedures and positions preferred by the IEEE. Guides are specifications that suggest alternative approaches to good practice, but make no clearcut recommendations.

The IEEE is accredited by ANSI, and can, therefore, submit its standards directly to the ANSI board of Standards Review. All new and revised IEEE standards are submitted to ANSI for review and adoption as ANSI standards. The IEEE also administers the secretariat or cosecretariat of 17 American National Standards Committees.

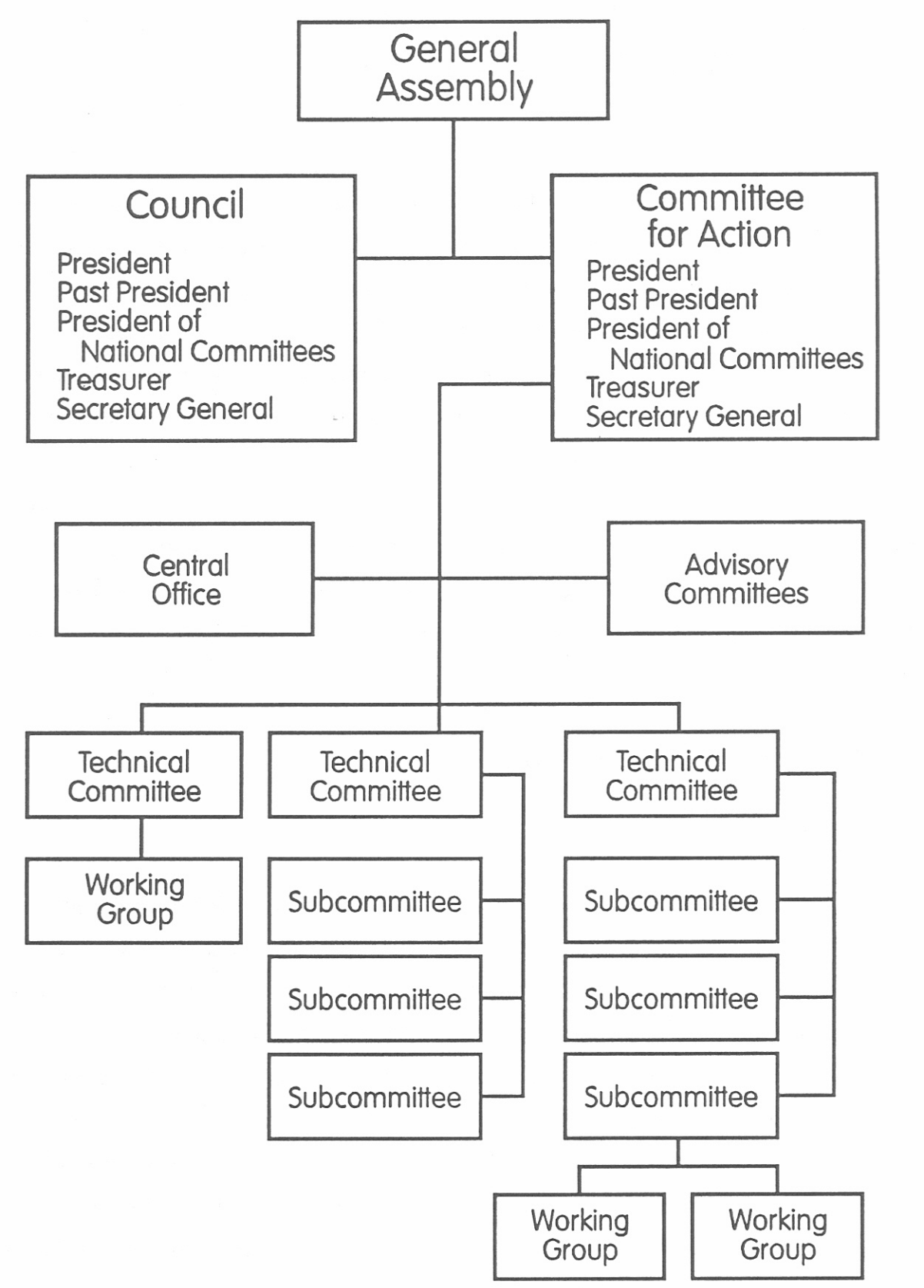


Figure A-7. Organization of the IEC.

Table A-7. Technical Committees and Subcommittees of the IEC

TC-12	Radio Communications
	SC-12A Radio Receiving Equipment
	SC-12C Radio Transmitting Equipment
	SC-12D Aerials (Antennas)
	SC-12E Microwave Systems
	SC-12F Equipment Used in Mobile Services
	SC-12G Cabled Distribution Systems
	SC-12H Written Message and Graphic Systems Primarily Intended for Use on Television Terminals
TC-13	Electrical Measuring Equipment
TC-18	Electrical Installations in Ships
	SC-18A Cables and Cable Installations
TC-46	Cables, Wires and Waveguides for Telecommunications Equipment
	SC-46A Radio Frequency Cables
	SC-46B Waveguides and Their Accessories
	SC-46C Low Frequency Cables and Wires
	SC-46D Connectors for Radio Frequency Cables
TC-47	Semiconductor Devices and Integrated Circuits
TC-48	Electromechanical Components for Electronic Equipment
	SC-48B Connectors
TC-57	Telecontrol, Teleprotection and Associated Telecommunications for Electrical Power Systems
TC-60	Recording
	SC-60C Systems of Audio-Visual and Electronic Technology (for Information and Communication
TC-65	Industrial-Process Measurement and Control
	SC-65A Systems Considerations
	SC-65C Digital Data Communications for Industrial-Process Measurement and Control Systems
TC-66	Electronic Measuring Equipment
TC-74	Safety of Data Processing Equipment and Office Machines
TC-76	Laser Equipment
TC-77	Electromagnetic Compatibility Between Electrical Equipment Including Networks
CISPR	International Special Committee on Radio Interference
ACET	Advisory Committee on Electronics and Telecommunications

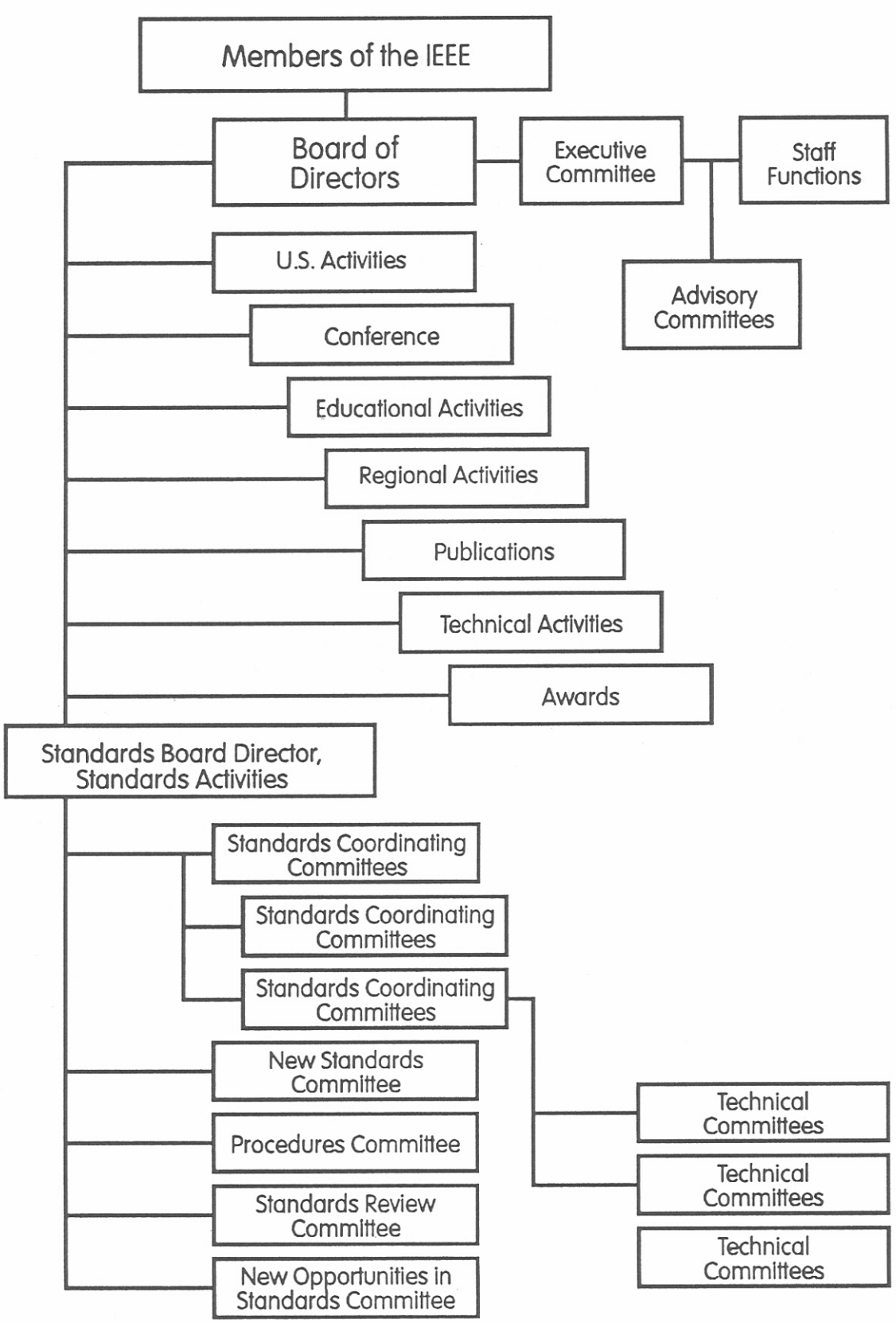


Figure A-8. Organization of the IEEE.

The IEEE Standards Board authorizes, coordinates, and approves all standards projects, and coordinates cooperation with other standards organizations. Standards are proposed and sponsored by technical committees of the IEEE Societies, standards committees, or Standards Coordinating Committees (SCC), depending on the scope of the work. Either these committees or standards subcommittees manage the actual standards development and balloting. Committees concerned with local area networks are listed in Table A-8.

IEEE membership is open to any dues-paying individuals. Standards participants are individuals, not companies or organizations. IEEE membership is required for voting, but not for participating in the development of draft standards. Approximately 30,000 members are active in standards development.

More than 500 IEEE standards exist, and more than 800 standards projects are underway. The most well known IEEE standards are the IEEE 802.3 CSMA/CD and 802.4 token bus LANS, IEEE-488 bus, the National Electrical Safety Code, and the Portable Operating System for Unix (POSIX) standards. The 802.3 and 802.4 standards are also approved ISO standards. The core POSIX standard (POSIX.1) has been submitted to ISO for approval as an ISO, as well as an IEEE standard. The POSIX.0 specifications will be a "Guide" to a POSIX Open Systems Environment.

Table A-8. IEEE Committees on Local Area Networks

802	Committee on Local Area Networks	
	Ad- Hoc	Ad Hoc Study Group on Functional Requirements for Integrating Voice and Data Communications
	802.1	Overall Architecture of LANs and Internetworking
	802.1A	Glossary
	802.1B	Network Management
	802.2	Logical Link Control
	802.3	Carrier-Sense Multiple Access with Collision Detection (CSMA/CD)
	802.4	Token-Passing Bus Access Method
	802.5	Token-Ring Access Method and Physical Layer Specification
	802.6	Metropolitan Area Networks
	802.7	Broadband Technical Advisory Group
	802.8	Fiber-Optics Technical Advisory Group

IFIP: International Federation for Information Processing

IFIP Secretariat
16 Place Longemalle
Geneva, Switzerland

The IAP does not develop standards but defines requirements for the formal standardization process. Working Group 6.6 of the IFIP is concerned with standards that are needed for network management and for network control for public and private networks. The aim of the group is to identify information that should be collected, forms of control that are needed, and information that should be exchanged. Work is done in the context of layered protocols such as OSI. The IFIP is a multinational organization representing 63 countries. The members organize symposia, conduct workshops, and maintain a technical library. Several technical committees and working groups meet periodically to work on various technical matters pertaining to computer science. A quarterly newsletter and conference proceedings are published by the organization.

IILC: Information Industry Liaison Committee

5430 Grosvenor Lane
Bethesda, MD 20814

This is an industry-wide committee sponsored by the ECSA. The IILC operates as an open forum of exchange carriers, enhanced service providers (ESPs), interexchange carriers, manufacturers, and end users. The committee meets regularly to resolve industry issues involving Open Network Architecture (ONA) issues including ONA standards at the direction of the FCC.

The IILC is composed of working committees that address the complex ONA issues and attempts to resolve them under the consensus resolution process. The organizational chart is shown in Figure A-9.

The structure consists of the full IILC, the Interindustry Advisory Group (IAG) and specific task groups. Their responsibilities are as follows: The full IILC is the deliberative body, which includes all IILC participants, in which final consensus approval on issues related to ONA is obtained. Other functions of the IILC include issue introduction and definition, ongoing issue review, and industry presentations and tutorials. The IAG supervises the administrative,

procedural, and logistical functions of the IILC and reviews recommendations from the task groups for adherence to the IILC Bylaws and procedures. Its constituency is representative of the interest groups that participate in the IILC. The task groups develop recommendations and consensus resolutions to those issues assigned by the full IILC or to those issues directly raised by participants on the task group.

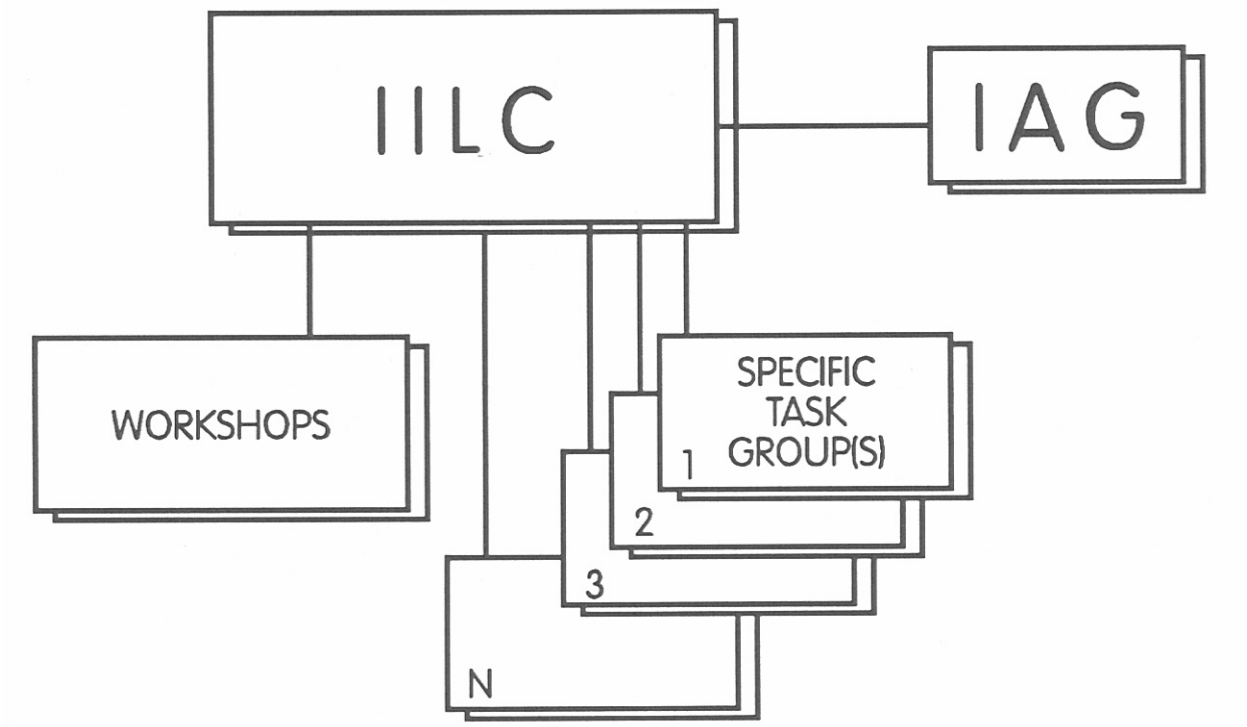


Figure A-9. Organization of the IILC.

ISO: International Organization for Standardization

Central Secretariat
1 Rue de Varembe, CH-1211
Geneva 40, Switzerland

The ISO is a nontreaty, voluntary international organization of 89 member nations; it's organizational structure is shown in Figure A-10. The ISO develops, coordinates, and promulgates international standards that facilitate world trade, contribute to the safety and health of the public, and help protect the environment. ISO standards cover telecommunications while electrical and electronic engineering standards are covered by IEC. The corollary objective of

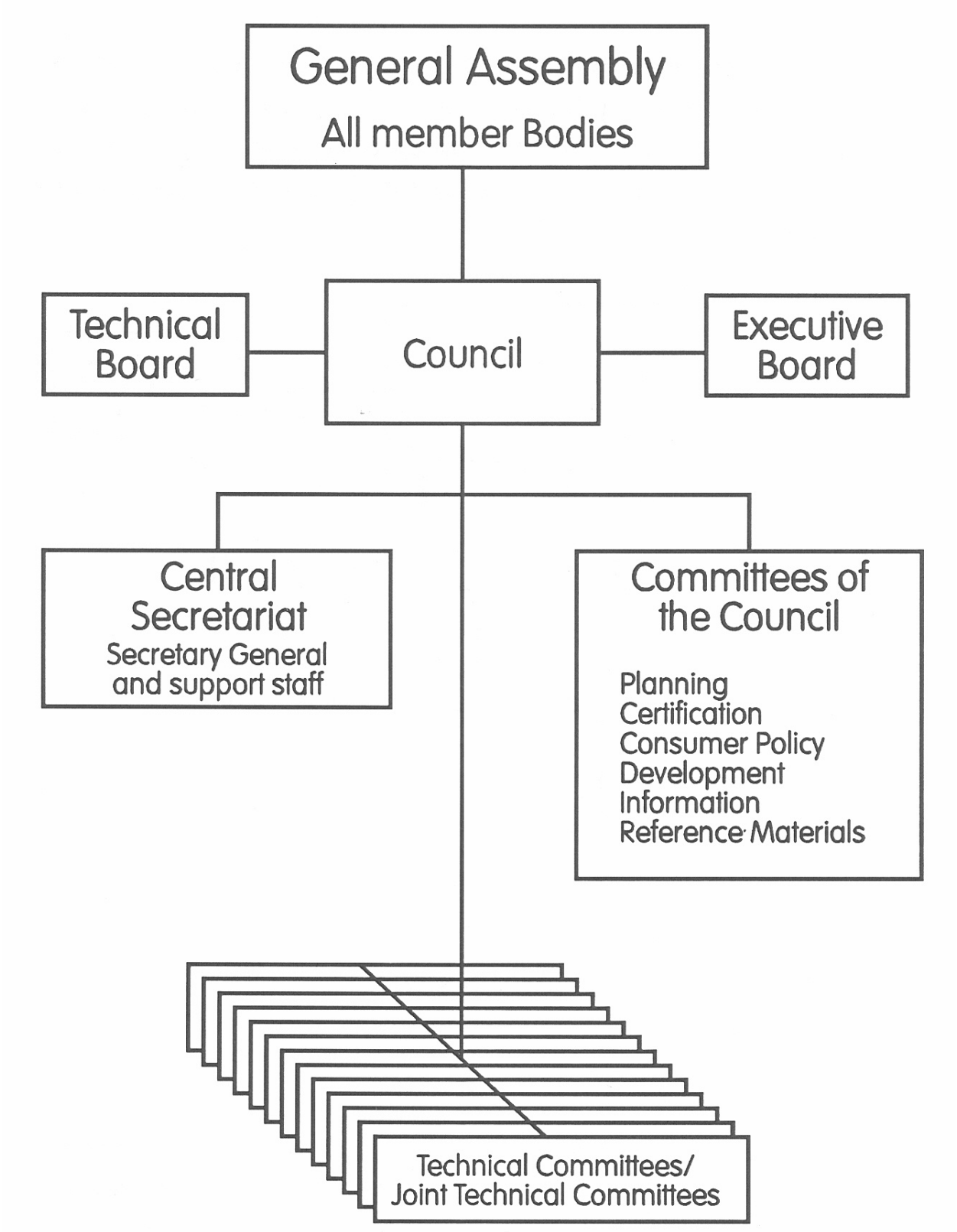


Figure A-10. Organization of the ISO.

ISO is to develop worldwide cooperation in the sphere of intellectual, scientific, technological, and economic activity.

The ISO was established in its present form in 1947 with the aim of reaching international agreement on standards. A voluntary, non-United Nations treaty, the ISO's membership consists of delegations from standards bodies in participating nations. The ISO solicits comments from other groups as well, including ECMA, the IEEE, the NIST, and the CCITT. The ISO has a close relationship with the CCITT, which is, perhaps, the most influential of all the observer groups within the ISO.

The ISO is responsible for the development and standardization of the Open Systems Interconnection model. It also considers items for standardization that were developed in other standards bodies, such as ANSI. A Joint Technical Committee JTC 1 is of particular interest here since certain subcommittees deal with NM activities. The JTC 1 is described separately.

ITU: International Telecommunications Union

Place de Nations, CH-1211
Geneva 20, Switzerland

The ITU is a formal treaty organization organized and operated under the auspices of the United Nations. The ITU organization structure is shown in Figure A-11. There are four permanent committees: the General Secretariat, the International Frequency Registration Board (IFRB), the International Radio Consultative Committee, and the International Telegraph and Telephone Consultative Committee. The CCITT is a primary concern here. It is described and a list of study groups concerned with network management are covered under the CCITT section. The CCIR also is covered in a separate section.

JTC 1: Joint Technical Committee 1

1 Rue de Varembe, CH-1211
Geneva 40, Switzerland

Organizational structure of the JTC 1 is shown in Figure A-12. The JTC 1, established in 1987, is the first joint committee of the ISO/TC97 (Information Processing System) and its subcommittees, with the IEC Technical Committee 83 (Information Technology Equipment) and

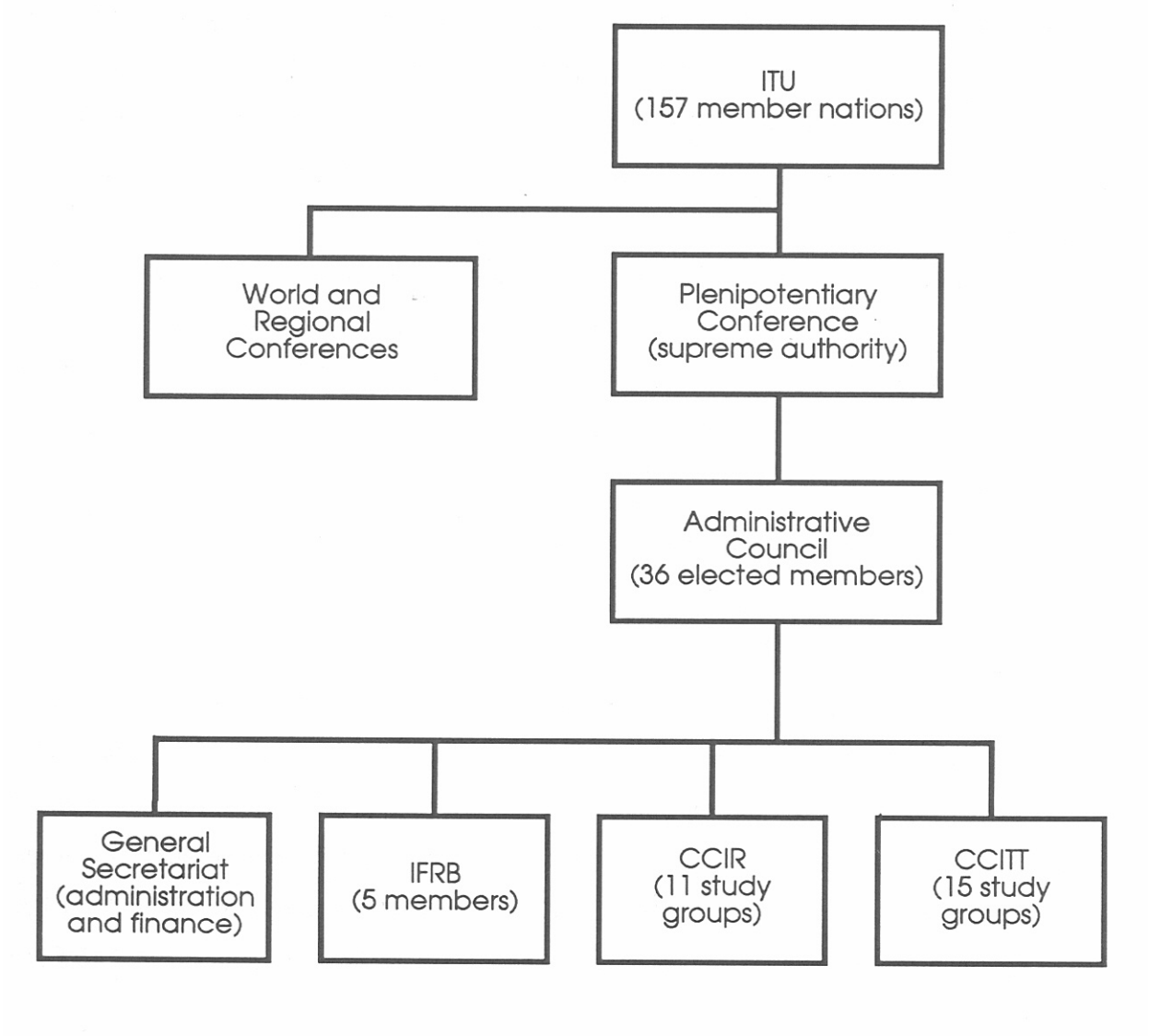


Figure A-11. Organization of the ITU.

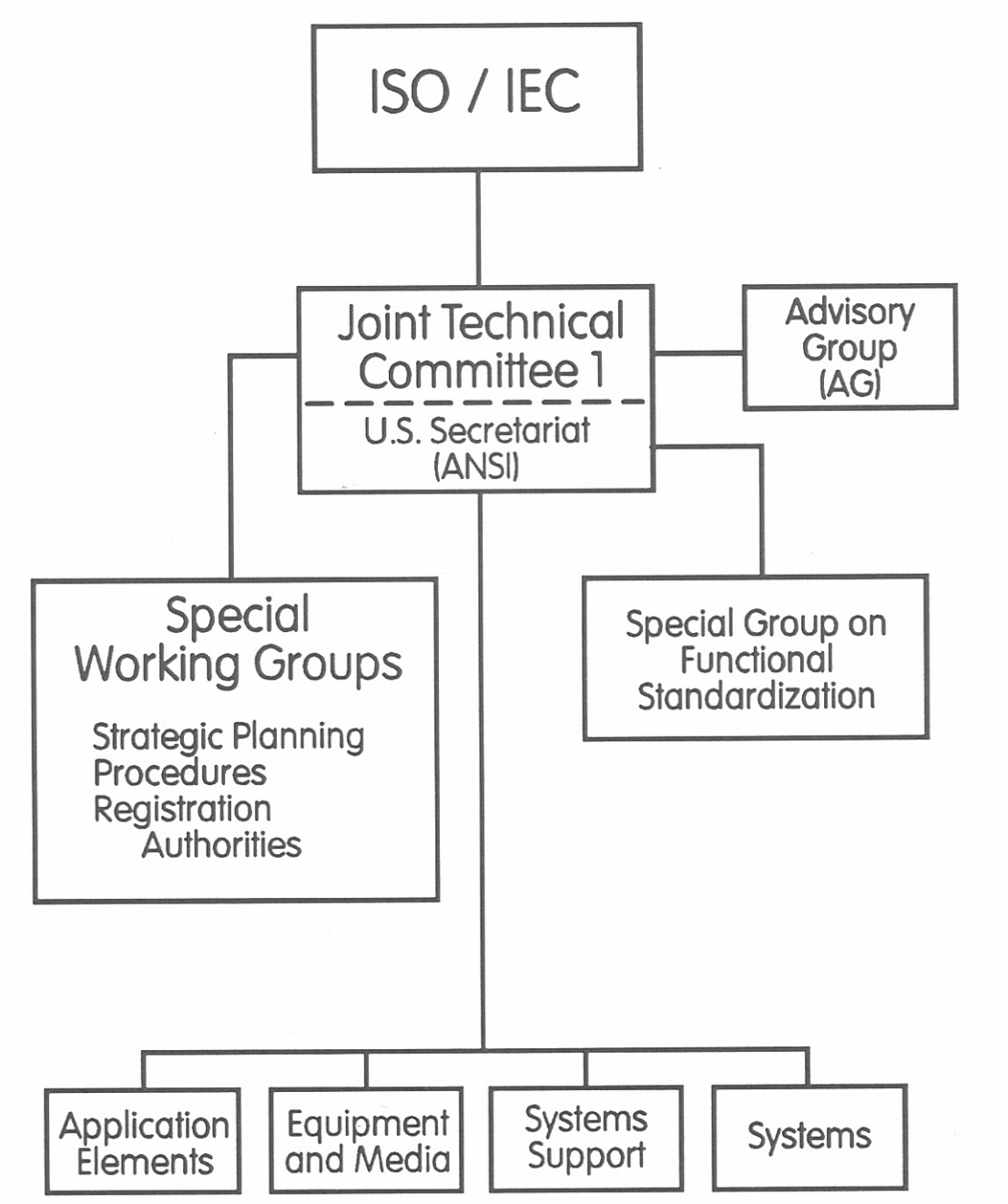


Figure A-12. Organization of the JTC-1.

the subcommittee IEC/SC47B (Microprocessor Systems). The four ISO subcommittees involved in the ISO/IEC merger are SC18 (Text and Office Systems), SC6 (Telecommunications and Data Communications), SC21 (Information Retrieval, Transfer, and Management for OSI), and SC11, (Flexible Magnetic Media for Digital Data Interface).

The JTC 1's purpose is to develop international standards in the areas of information technology systems (including microprocessor systems) and equipment. Microprocessor systems include, but are not limited to, microprocessor assemblies and the related hardware and software for controlling the flow of signals at the terminals of microprocessor assemblies.

The JTC 1 has established four major technical committees, each of which contains subcommittees that, in turn, contain working groups as listed in Table A-9. Network management standards are conducted primarily by two subcommittees, SC6 and SC21, both within the systems group of JTC 1.

Table A-9. Committees and Subcommittees of the JTC 1

JTC 1	Application Elements Group	
	SC1	Vocabulary
	SC7	Design and Documentation of Computer-Based Information Systems
	SC14	Representation of Data Elements
	SC22	Language
JTC 1	Equipment and Media Group	
	SC11	Flexible Magnetic Media for Digital Data Interchange
	SC15	Labeling and File Structure
	SC17	Identification and Credit Cards
	SC23	Optical Digital Data Disks
JTC 1	Systems Group	
	SC6	Telecommunications and Information Exchange Between Systems
	SC13	Interconnection of Equipment
	SC18	Text and Office Systems
	SC21	Information Retrieval, Transfer, and Management for OSI
JTC 1	Systems Support Group	
	SC2	Character Sets and Information Coding
	SC20	Data Cryptographic Techniques
	SC24	Computer Graphics
	SC47B	Microprocessor Systems
	SC83	Information Technology Equipment

North American ISDN Users (NIU) Forum

% National Institute of Standards and Technology (NIST)
Technology Building 225
Gaithersburg, MD 20899

The North American ISDN Users Forum, established by industry and coordinated by NIST, is intended to provide network users with a platform for voicing their needs for standards and to facilitate development of implementation agreements by bringing users and vendors together. These agreements may be formalized as Federal Information Processing Standards (see NIST, in Section A-3) and subsequently lead to ANSI or other standards. The Forum consists of two workshops: one for ISDN users and one for ISDN implementors. The User's Workshop is set up to develop requirements for specific business applications for ISDN, whereas the Implementor's Workshop prepares specification agreements necessary to implement the applications. The activities within the two workshops are coordinated by the NIU Forum's Executive Steering Committee. Contributing to the work of the forum is the OSI Implementor's Workshop and the Corporation for Open Systems. Also involved are user organizations (such as General Motors) that have been deeply involved in the development of MAP (Manufacturing Automation Protocol) and Boeing in the development of TOP (Technical Office Protocol).

NRC: Network Reliability Council

Federal Communications Commission
Common Carrier Bureau, Domestic Facilities Branch
1919 M Street, NW
Washington, DC 20554

The NRC was formed by the FCC after a number of PSTN outages occurred in the early 1990s. The council is composed of users, carriers, equipment vendors, and state regulators. A key mission of the NRC is to recommend to industry and regulators methods for assuring communications systems reliability and network availability standards.

OSI/Network Management Forum

40 Morristown Road
Bernardsville, NJ 07924

The OSI/Network Management Forum is a consortium of more than 60 vendor members in eleven countries focusing on delivery of interoperable network management systems based on OSI standards. The Forum policy is to develop interim technical standards, using existing and draft standards (primarily ISO and CCITT), that demonstrate interoperable network management in heterogeneous environments, and thus fill in the gaps where there are no firmly-established standards. When international standards are formalized, the Forum complies with them.

The Forum considers cooperation with other international standardization bodies a priority. It recently announced alliance with the Corporation for Open Systems International (COS) and the European Standards Promotion and Application Group (SPAG, COS's European counterpart), two organizations which work to advance conformance testing of OSI protocols.

The Forum released documentation in October 1990, that specifies a complete implementation of the Forum's interoperable interface for the exchange of network management information. Known as Release #1, these specifications consists of the nine documents described in the reference OSI/NM Forum (1990).

TIA: Telecommunications Industry Association

Suite 800
2001 Pennsylvania Avenue, NW
Washington, DC 20006-1813

The TIA is a trade association formed in 1988 through a merger of the Telecommunications Technology Group of the EIA and the United States Telecommunications Suppliers Association (USTSA). TIA, while still affiliated with EIA, is actually a separate corporate entity. The TIA recently (May 1991) submitted its application for accreditation by ANSI. TIA is expected to play a leading role in developing standards for telecommunications equipment and systems, fiber optic components and systems, mobile and cellular radio equipment.

U.S. CCITT: United States Organization for CCITT

U.S. Department of State
Eye Street, NW
Washington, DC 20520

The U.S. CCITT is a national committee headed by the Office of International Communications Policy in the U.S. State Department which is the government entity responsible for the U.S. position on matters in the ITU. The U.S. CCITT is open to all interested parties including users, manufacturers, national standards organizations, and government organizations. The U.S. CCITT operates four study groups and one joint working party as shown in Figure A-13. These study group's technical work primarily consists of reviewing contributions that are submitted for forwarding to the CCITT.

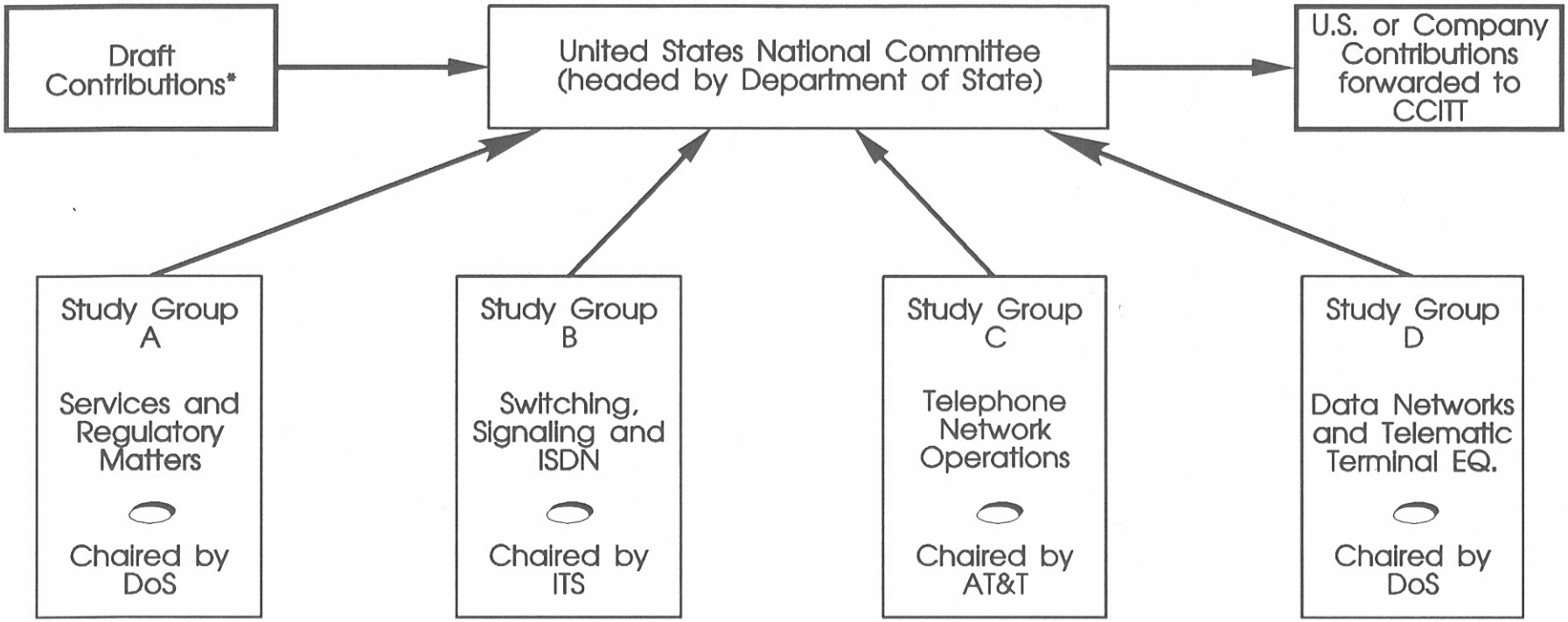
U.S. JTC 1 TAG: U.S. Joint Technical Committee 1 Technical Advisory Group

311 First Street, NW, Suite 500
Washington, DC 20001-2178

This technical advisory group (TAG) was created--not to write standards but to provide the formal structure for establishing the U.S. position in JTC-l activities. ANSI assigned CBEMA as the secretariat of this TAG.

As issues arise between standards development organizations in the U.S., the TAG creates advisory committees (ACs) to deal with them. Organizations involved include ASC T1, ASC X3, EIA, IEEE, and others. U.S. positions are funneled through ANSI, the U.S. voting member to ISO/IEC JTC1 via the CBEMA, the TAG Secretariat. As issues surface that impact more than a single standards development organization, the JTC 1 TAG creates special working groups (SWG) or study committees, or uses other mechanisms, to deal with these cross-organizational issues.

Figure A-14 shows the organization and composition (in 1992) of the JTC 1 TAG. Membership is open to members of X3 and any United States standards development organization impacted by standardization or wanting to participate in helping to advise ANSI on U.S. positions for the JTC 1. The group meets three times a year, usually but not always in conjunction with the X3 meeting. Because questions do not always arise at the convenience of



* Contributions are submitted from Committee T1, ROPA's, scientific organizations, and industrial organizations.

Figure A-13. Organization of the U.S. CCITT.

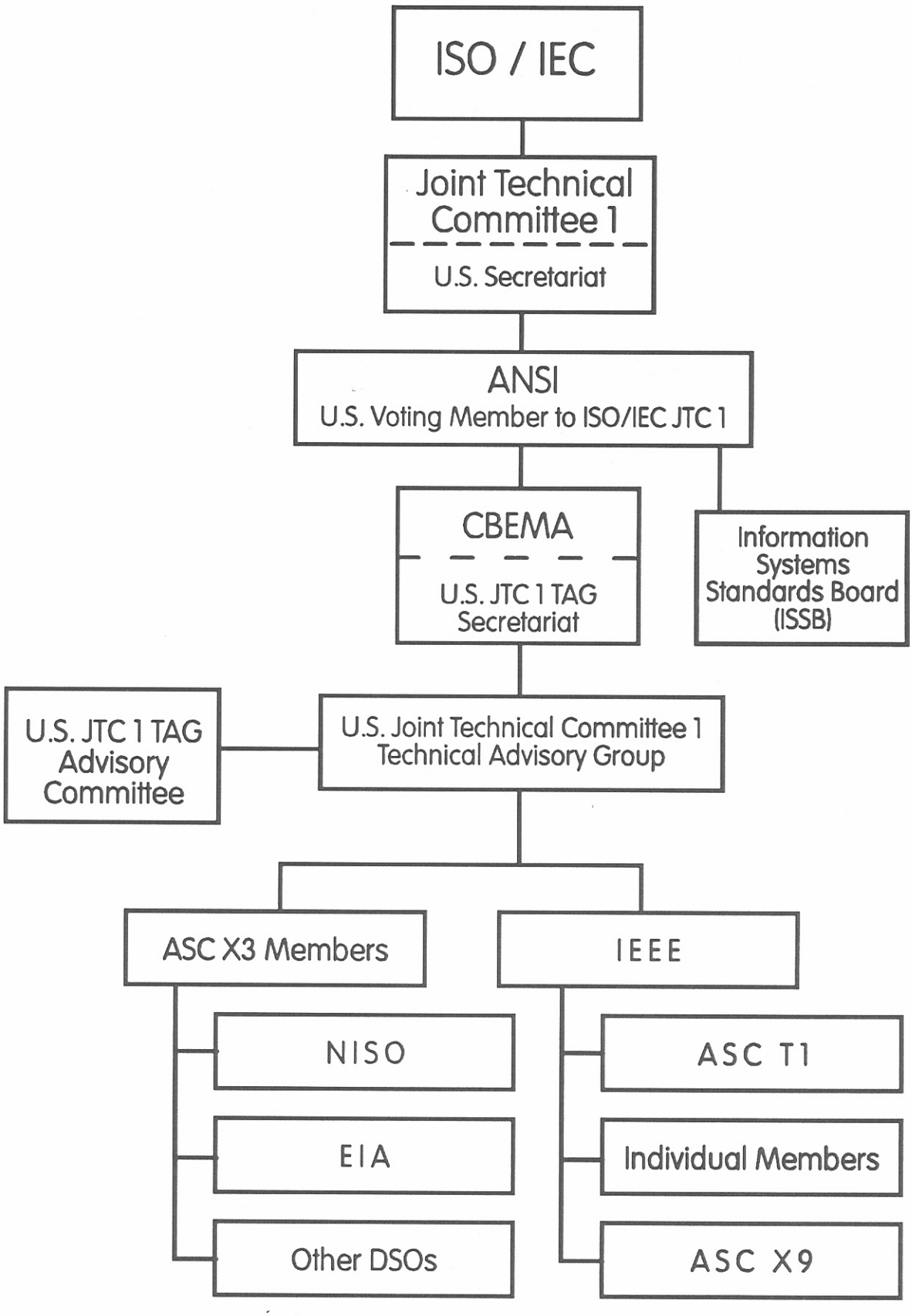


Figure A-14. Organization of the U.S.-TCT1 technical advisory group.

the full TAG, a subcommittee has been formed to deal with the more pressing issues quickly. The JTC 1 TAG Advisory Committee meets on a more frequent basis than the full TAG and acts for it in developing positions for the ANSI delegates to ISO.

A-3 U.S. GOVERNMENT STANDARDS ORGANIZATIONS

The United States Government is involved in a number of standards organizations and in addition has its own standards making organization because the Government is involved in the procurement of telecommunications and information processing systems. This governmental procurement process under the auspices of the Government Services Administration (GSA), uses Federal Telecommunication Standards (FEDSTDS), and Federal Information Processing Standards (FIPS). In addition, military standards (MILSTDS) are used in the specification of military system procurements. Organizations involved in developing these government standards are shown in Figure A-15 and the acronyms defined in Table A-10. Many of these organizations are represented in the national and international standards arena. Every effort is made to incorporate Federal requirements into the commercial standards. Only as a last resort are special standards developed. Usually such special standards are compatible with commercial counterparts. In addition, the Department of Commerce is involved in the standards making process particularly in the National Institute for Standards and Technology (NIST) (the former National Bureau of Standards). These and other organizations shown in Figure A-15 are described in the following paragraphs.

Center for Standards

Joint Command, Control, and Communications Agency
Fort Monmouth, NJ

The Center is responsible for the life-cycle management of all tactical and strategic communications and control standards within DISA to include development, testing and training, implementation, configuration management, and exportation and harmonization. The mission of the Center for Standards is to achieve centralized management of DoD standards activities by maintaining cognizance over standards activities (both joint and combined), validating, prioritizing, coordinating, controlling, and guiding standards activities in general, as well as

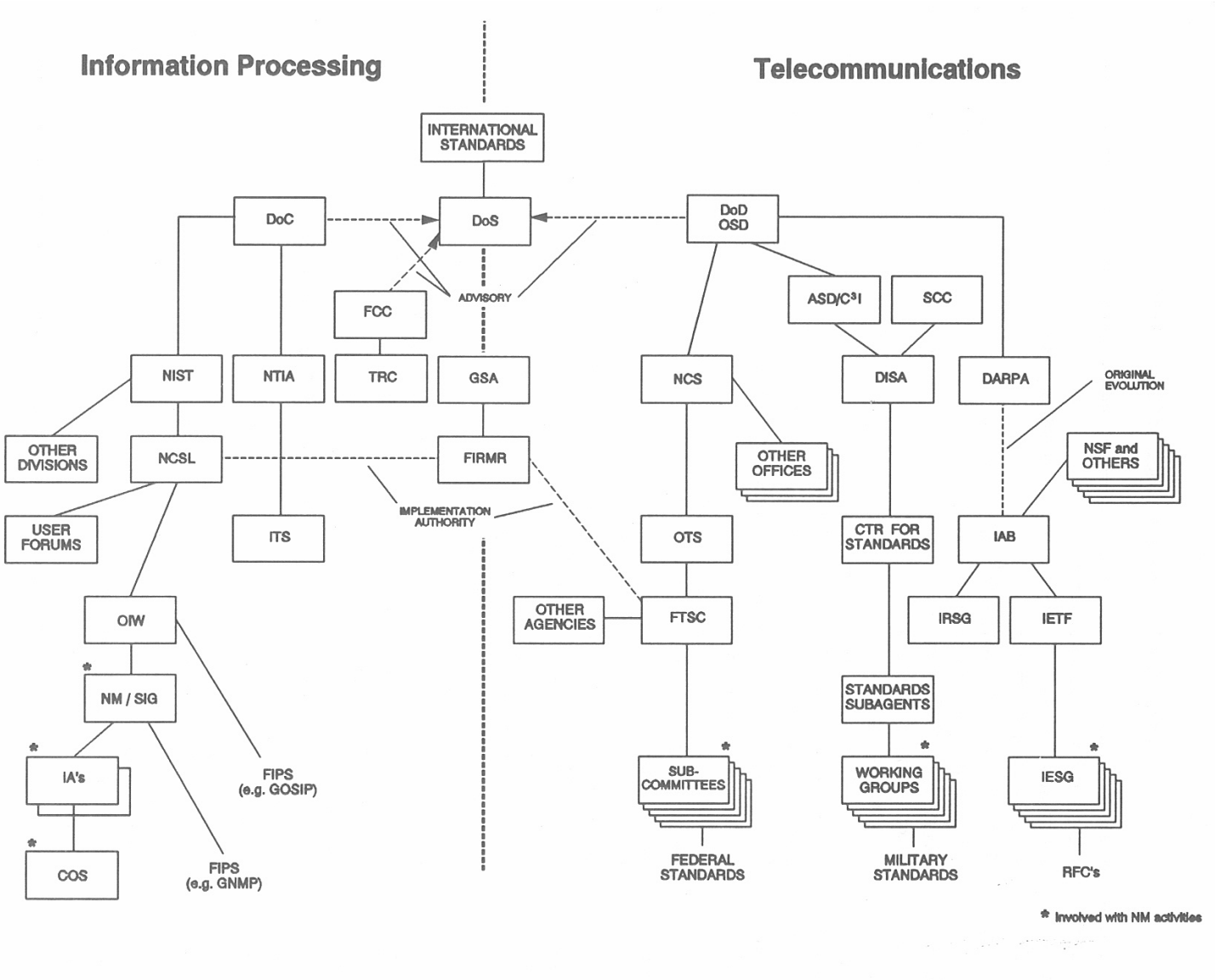


Figure A-15. United States Government standards organizations.

Table A-10. Acronyms Used in Figure A-15

ASD	Assistant Secretary of Defense
C3I	Command, Control, Communications and Intelligence
COS	Corporation for Open Systems
DARPA	Defense Advanced Research Projects Agency
DISA	Defense Information Systems Agency
DoC	Department of Commerce
DoD	Department of Defense
DoS	Department of State
FCC	Federal Communications Commission
FIPS	Federal Information Processing Standard
FIRMA	Federal Information Resources Management Relations
FTSC	Federal Telecommunication Standards Committee
GNMP	Government Network Management Protocol
GOSIP	Government Open Systems Interconnection Protocol
GSA	General Services Administration
IA	Implementation Agreement
IAB	Internet Activities Board
IEEE	Institute of Electrical and Electronics Engineers
IESG	Internet Engineering Steering Group
IETF	Internet Engineering Task Force
IRSG	Internet Research Steering Group
ITS	Institute for Telecommunication Sciences
NCS	National Communication System
NCTL	National Computer and Telecommunications Laboratory
NIST	National Institute of Standards and Technology
NM	Network Management
NSF	National Science Foundation
NTIA	National Telecommunications and Information Administration
OIW	OSI Implementors Workshop
OSD	Office of the Secretary of Defense
OSI	Open Systems Interconnection
OTS	Office of Technology and Standards
RFC	Request for Comment
SC	Subcommittee
SCC	Standards Coordination Committee
SIG	Special Interest Groups

assigning responsibilities for specific projects. The primary goal of the Center is to guide the development of standards within the DoD and to encourage industry adoption of standards which support DoD requirements. To this end, the Center chairs steering groups which manage standards within DoD, coordinates and controls DoD participation in the domestic and international standards process, and represents the DoD concerning the exportation of standards to allied nations.

The center is expected to be organized with directorates for security, telecommunications, information, and information processing as shown in Figure A-16. Network management activities fall under the telecommunications directorate. The organization chart is shown in Figure A-16. The Standards Steering Committee (SSC) develops options and guidelines for the executive agent (The Defense Information Systems Agency) to follow based on Jointly Required Operation Capability (JROC) documents. The executive agent oversees the activities of three subagents for telecommunications, information, and information processing. These subagents act as a focal point for specific areas of standards and oversee the activities of the Standards Management Committees (SMCs).

COS: Corporation for Open Systems

1750 Old Meadow Road, Suite 400
McLean, VA 22102-4306

The COS is a consortium of vendors and users formed in 1985 to accelerate the development and commercial availability of interoperable computer and communications equipment and services that conform to ISDN, the Open System Interconnection model, and related international standards. Membership in COS includes representatives from most of the larger United States industries in the communication and information field. The purpose is "to provide an international vehicle for accelerating the introduction of interoperable multivendor products and services operating under agreed-to open systems interconnection, integrated services digital network, and related international standards to assure acceptance of an open network architecture in world markets."

Like similar efforts in Europe and Japan, the COS is not explicitly a forum for devising digital communication standards but plays a significant role in promoting such standards and

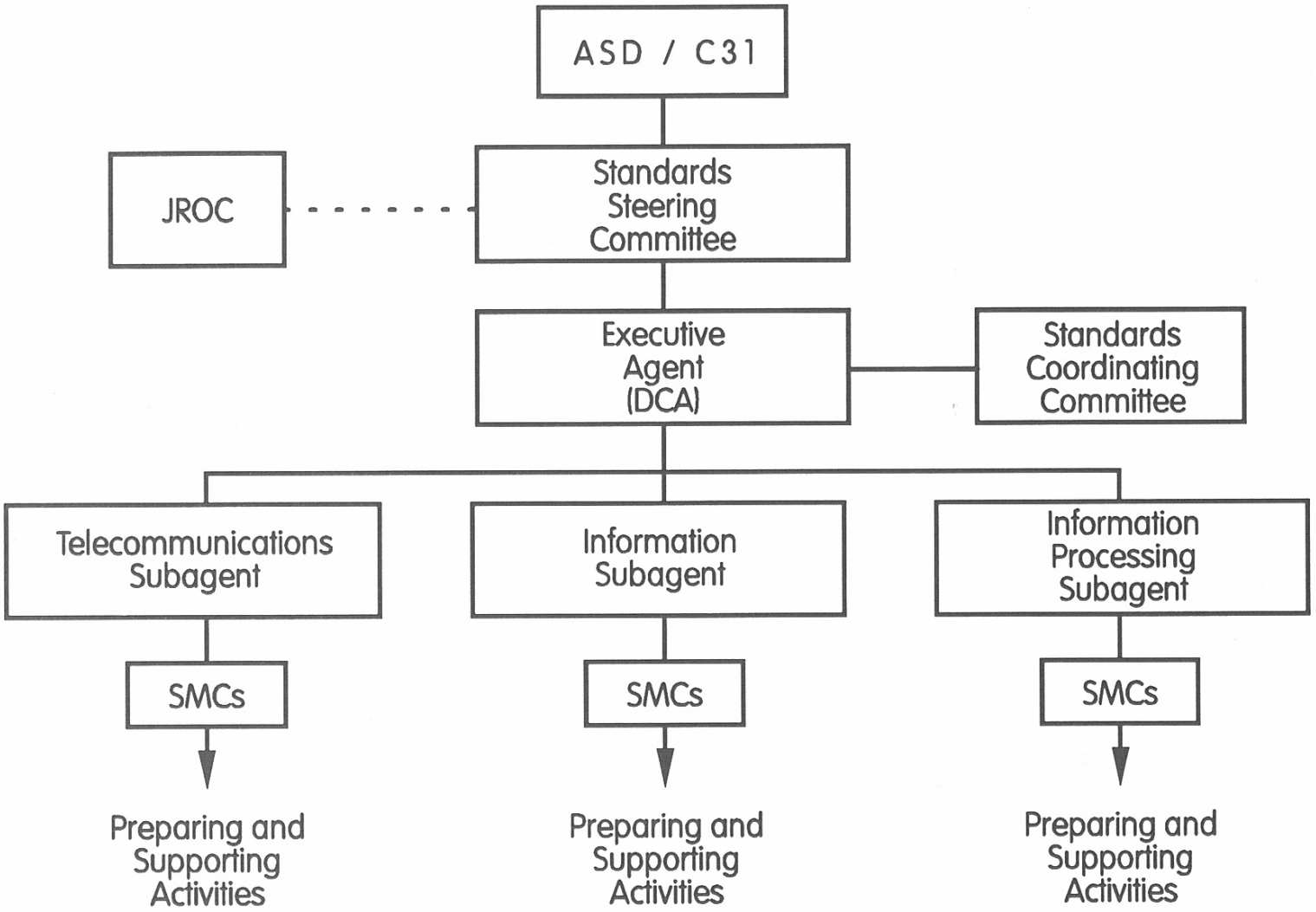


Figure A-16. Organization of the Center for Standards.

embellishing them through testing specifications and programs. Most of the standards-related activity is now centered in the Architecture Committee under the guidance of the Strategy Forum Committee.

DARPA: Defense Advanced Research Projects Agency

1400 Wilson Boulevard
Arlington, VA 22204

This research agency funded the packet-switched network research and pioneered the packet-switched technology with ARPANET (a conventional, leased-line, computer network), radio networks, and satellites. In the 1980s, ARPANET evolved into the TCP/IP Internet that connects most major research institutions in the United States including universities, corporate, and government laboratories. Internet includes over 3,000 networks and connects over 200,000 computers today. The TCP/IP protocol suit used on Internet has become a defacto standard for internetworking. Internet evolution is now guided by an Internet Activities Board (IAB) rather than DARPA. A broadband network similar to Internet called the National Research and Education Network (NREN) is in the planning stages but requires congressional approval for funding.

DoD: Department of Defense and DISA: Defense Information Systems Agency

DISA Headquarters
Arlington, VA

Communication standards for the DoD are developed under the guidance of the Joint Steering Committee whose members come from various military departments and agencies. DoD has the responsibility for standards and delegates development authority to various military departments as shown previously in Figure A-15.

Military standards are documents issued within the Department of Defense in accordance with the basic policy of the Defense Standardization and Specification Program. Military standards are used for the comprehensive presentation of engineering practices (including test methods), procedures, processes, codes, safety requirements, symbols, abbreviations, nomenclatures, type designations and characteristics for standard equipments or items, either

singly or in families. Military standards are also used to cover overall characteristics of families of end items or major components. These characteristics include, as applicable, envelope dimensions, performance ratings, primary structural features, and data required for interchangeability of components.

The NCS is concerned with non-military communications networks. National Security and Emergency Preparedness (NS/EP) and the Federal Telecommunications Standards Program (FTSP) are two important functions assigned to the National Communication System (NCS) with the Secretary of Defense as Executive Agent.

The DISA (formerly the Defense Communication Agency) is the lead DoD information systems standards organization. DISA serves as a single focal point to achieve a coordinated DoD position as well as insuring interoperability of information systems at a reasonable cost. DISA also represents DoD in Federal, national, and international organizations such as NIST, ANSI, CCITT, ISO, and the North Atlantic Treaty Organization (NATO) (DCA, 1989).

FCC: Federal Communications Commission

Office of Congressional and Public Affairs
1919 M Street, NW
Washington, DC 20554

Enabled by the Communications Act of 1934, the FCC is the principal regulatory agency for telecommunications in the United States. The FCC's regulatory scope is broadly subdivided into two major categories under its statutory charter, the Communications Act of 1934: "common carrier" telecommunication services and the use of radio stations. In addition, the commission has a kind of general jurisdiction over all telecommunication services, common carrier and otherwise, which has been interpreted to include ancillary information systems.

The FCC exercises its power in a variety of ways. It authorizes companies or individuals to provide common-carrier services or use radio facilities or undersea cable facilities. It prescribes certain technical and operational criteria for telecommunication systems and equipment, and the rates that market-dominant providers of common-carrier services may charge. It certifies that equipment complies with certain technical standards. The FCC also, in cooperation with the departments of State and Commerce, determines USA positions with respect to activities of international organizations and negotiations with foreign governments.

The important documents adopting rules and policies are published as part of the commission's permanent legal record, the Federal Communications Commission Reports, as well as in the Federal Register. The commission's rules are contained in Title 47 of the Code of Federal Regulations. All the materials associated with any particular proceeding are contained in a "docket" file at commission headquarters.

The Commission's explicit digital network standards, to the extent they exist, are found in Part 68 of the FCC's Rules and Regulations, which covers the interconnection of terminating equipment with the network. An industry advisory committee also has been created to provide additional input on this subject.

The FCC's policies emanating from rule/policy-making proceedings and the authorization of particular services under tariff can have far-reaching effects on digital network standards. For example, the commission has ruled that network channel terminations be provided at the so-called "U" interface for channel terminating equipments.

FTSC: Federal Telecommunications Standards Committee

Office of Technology and Standards
8th Street and South Court House Road
Arlington, VA 22204

The NCS established the Federal Telecommunications Standards Committee (FTSC) under the Federal Technical Standards Program (FTSP) as a management and advisory body to assist in the administration of the standards development activities. Sixteen Federal agencies, shown in Figure A-17, are now active and contribute to the work. The focus has been on digital transmission and data communications, including application of the new OSI architecture. The objective is to achieve full interoperability through evolution of the Federal Systems. These Federal Standards are for Government agencies acting as users of telecommunications, rather than acting as Government regulators of commercial interests.

The Federal Telecommunication Standards Program develops, coordinates, and approves federal standards affecting NS/EP communications. During FY 90, the emphasis was on HF and mobile radio; facsimile and telematics; digital transmission, including optical fiber systems and broadband integrated services digital networks (BISDN); and automated network management. A primary component of the work is participation in public standards committees. Participation

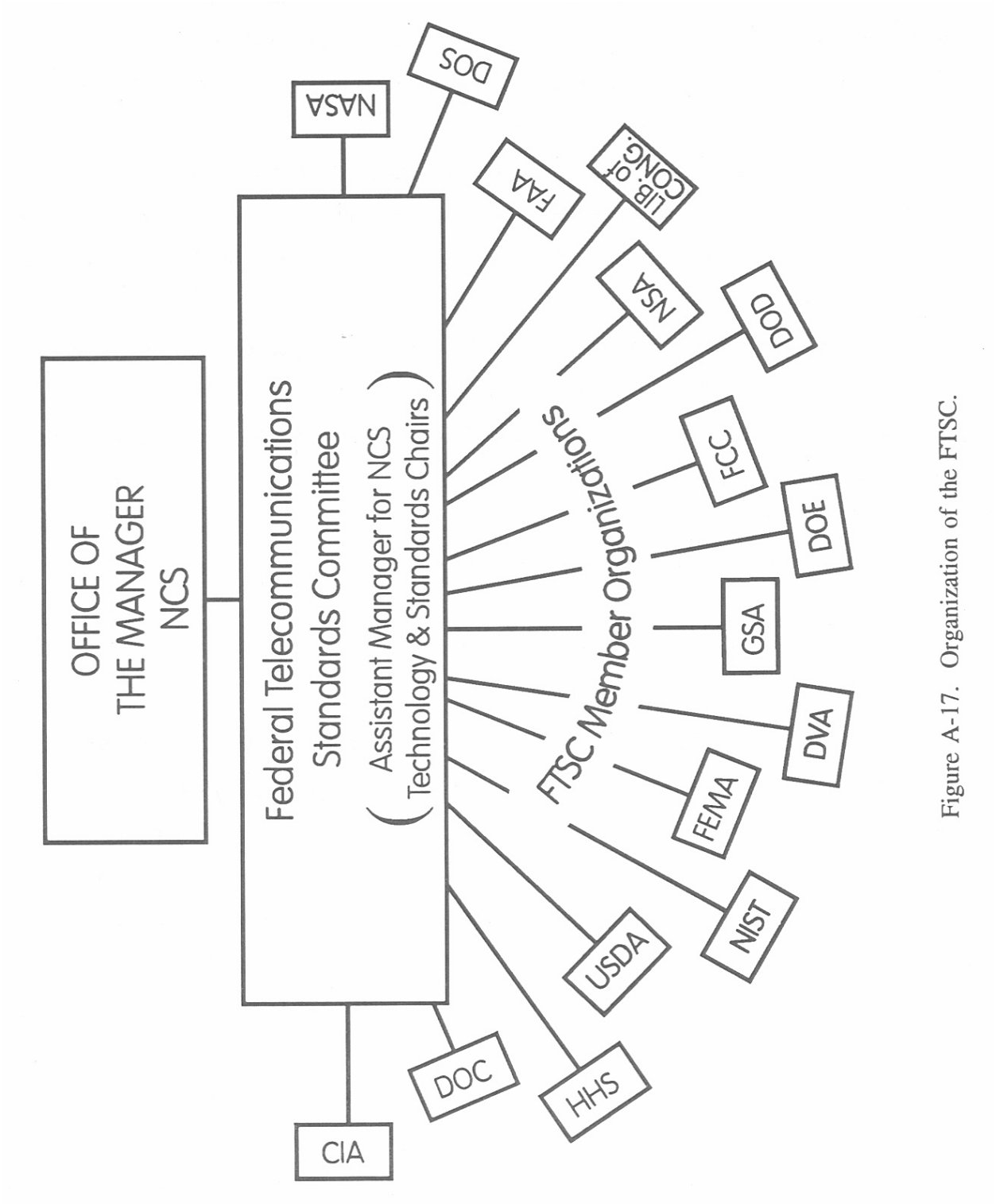


Figure A-17. Organization of the FTSC.

provides insight into the type and rate of implementation of new technology into telecommunications systems, and provides an opportunity to ensure that NS/EP requirements are considered as new commercial standards are developed. The primary standards organizations are the American National Standards Institute, the Electronic Industries Association and the Telecommunications Industries Association, the Consultative Committee on International Telegraph and Telephone, and the International Standards Organization. Office of the Manager, NCS personnel regularly participate in the work of over 35 standards committees.

Much of the interagency work of the FTSP is done by the FTSC. This committee approves standards development projects and the resulting standards. Usually, the preferred source of a new standard is a commercial standards committee, even though these standards must be adapted to meet Government requirements. Use of commercial standards allows the Government to benefit from competitive pricing of commercial equipment and aids interconnection of government systems with commercial systems when restoration is necessary. If a suitable commercial standard is not available, the FTSC may decide to allow the OMNCS, another government agency, or a contractor to develop the standard. Example of standards developed outside the commercial standards committees during the last year are those for HF radio, land mobile radio, and meteor burst communications. Standards and reports related to facsimile and telematics were developed by a contractor. As an aid to its members in determining standards requirements, the FTSC serves as a technical forum for briefings, seminars, and discussions on emerging telecommunications.

GSA: General Services Administration

18th and F Street, NW
Washington, DC 20405

The General Services Administration was established under the Federal Property and Administrative Services Act of 1949, in which the GSA was authorized to prescribe standard purchase specifications and to direct their use in the governmental procurement process. To carry out this charge, the GSA developed the Federal Standardization Program, which covered all product standardization efforts in the federal government. The GSA normally delegated developmental responsibility to another agency but retained the authority to approve and

implement its standards for the government. The primacy of the national consensus standards method as a source for standards is acknowledged by GSA.

In 1965, the Brooks Act transferred the responsibility for Automatic Data Processing (ADP) standards development from the Federal Standardization Program to the NBS/ICST (now NIST/NCSL), and, in 1972, development of telecommunications standards was moved to the National Communication System, a branch of the Department of Defense. A 1987 amendment to the Brooks Act redefined certain standards as ADP, rather than telecommunications, which moved them to the NIST, where they presently reside under the FIPS program. The GSA, however, retains implementation authority for these standards under the authority of the Federal Information Resources Management Relations (FIRMR).

Since its creation in 1949, the GSA has seen two major areas of standards development removed from its control--the two areas that experience the highest level of change and the greatest need for technological expertise. However, because it has a substantial voice in determining procurement methodologies and because it is viewed as the caretaker of the governmental standards effort, the role of GSA as the ultimate arbitrator of implementation standards is important. The GSA has the final authority in one of the most important areas of governmental programs for standardization--deciding who can sell/buy what to/from whom. It is the economic aspect of a standard that makes it valuable, and it is this aspect over which the GSA exerts power.

GSA defines standards and several categories of standards as follows:

> Standard. A document that establishes engineering and technical requirements for processes, procedures, practices and methods that have been adopted as standard. Standards may also establish requirements for selection, application and design criteria for material.
>
> Standard, Departmental. A standard prepared by, and of interest primarily to a particular Federal agency, but which may be used in procurement by other agencies.
>
> Standard, Federal. A standard, issued in the Federal series, which is mandatory for use by all Federal agencies. These documents are issued or controlled by General Services Administration and are listed in the GSA Index of Federal Specifications, Standards, and Commercial Item Descriptions.

Standard, Interim Federal. A potential Federal standard issued in interim form for optional use by all Federal agencies. These documents are issued or controlled by the General Services Administration, primarily for use in the telecommunication functional area.

Standard, Regulatory. A standard issued by a regulatory agency pursuant to an Act of Congress and thus mandatory for all Federal agencies. Such standards are usually published in the Federal Register and incorporated in the Code of Federal Regulations.

IAB: Internet Activities Board

Network Information Center
Stanford Research Institute
Menlo Park, CA

The IAB sets policies for the nationwide Internet and serves as the official committee for TCP/IP-related standards that are issued as Requests for Comments (RFCs) and available from the Network Information Center in California. IAB standards and policies form the basis for vendor product requirements and set the direction for the TCP/IP marketplace.

The IAB was reorganized in 1989. As shown in Figure A-18, the IAB includes two major groups: the Internet Research Task Force and the Internet Engineering Task Force (IETF). The IETF chairman and the eight IETF area managers comprise the Internet Engineering Steering Group, the individuals responsible for coordinating all efforts of IETF working groups. The IRTF coordinates research activities related to TCP/IP protocols or internet architecture in general. Like the IETF, the IRTF has a small group called the Internet Research Steering Group or IRSG, that sets priorities and coordinates research activities. Unlike the IETF, however, the IRTF is a much smaller organization. Each member of the IRSG chairs a volunteer Internet Research Group analogous to the IETF working groups; the IRTF is not divided into areas.

Internet is a heterogeneous collection of computer networks that organized in a hierarchy of local networks, midlevel networks, and backbone networks. The main Internet backbones are MILNET and NSFNET funded mostly by government grants. Campus area networks are funded mostly by local organizations. Generally, there are no per user or per message charges. Internet today also includes networks in Canada, Western Europe, and the Pacific Rim. Recent estimates places the number of users reachable on Internet at over 3 million. All hosts and networks in

the Internet use the TCP/ID protocols. Practical coordination of the entire Internet is provided by the Network Information Center (NIC) in Menlo Park, CA. The network operation center (NOC) is located in Cambridge, MA. Estimates of the number of hosts range from 40,000 to 500,000 and number of users from 1 to 3 million.

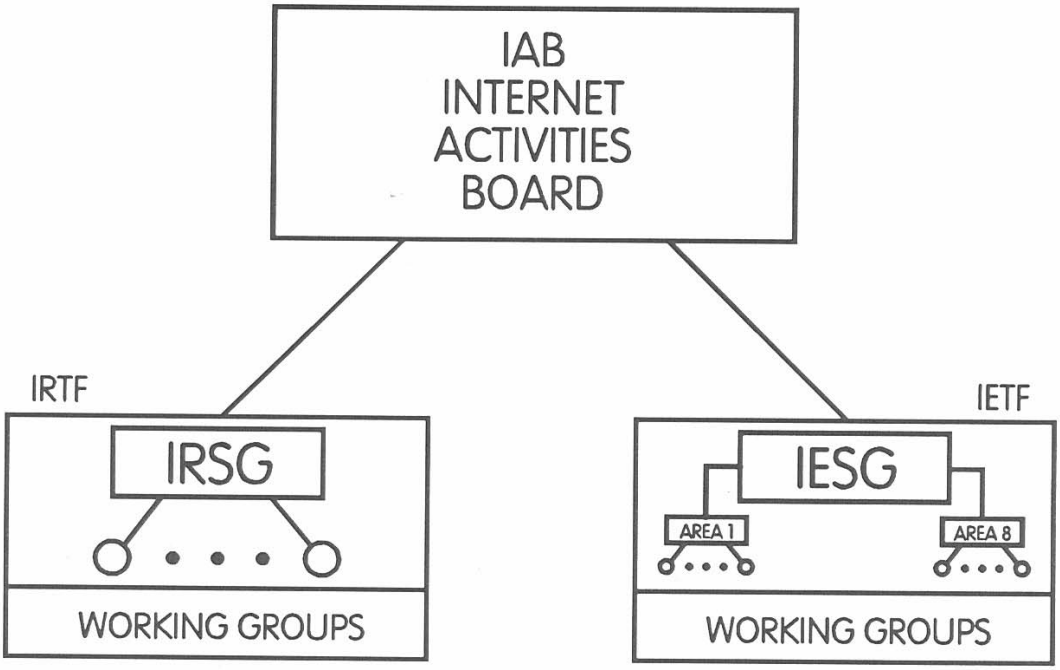


Figure A-18. Organization of the IAB.

ITS: Institute for Telecommunication Sciences

325 Broadway
Boulder, CO 80303

The Institute for Telecommunication Sciences, located in Boulder, Colorado, is the chief research and engineering arm of the National Telecommunications and Information Administration (NTIA), U.S. Department of Commerce. ITS employees bring substantial engineering and scientific backgrounds and skills to technically oriented programs.

Much effort within ITS is focused on the development and application of national and international technical performance standards to facilitate competition in the provision of enhanced telecommunication products and services. Additionally, ITS develops standards for military communication applications.

Nationally, ITS efforts address a growing need for efficient means of relating the voice, data, and video communication performance requirements of end users with the capabilities of competing system and network offerings. The Institute has pioneered the development of methods and procedures for specifying and measuring performance of these communication systems and services as seen by the end user. Major end products are Federal and American standards developed under the auspices of the Federal Telecommunication Standards Committee (FTSC) and the American National Standards Institute, respectively.

The International effort addresses the need for technically strong, broadly based U.S. contributions to international standards organizations. The Institute participates in and contributes to the efforts of various international Study Groups functioning under the aegis of the International Telecommunication Union's International Telegraph and Telephone Consultative Committee and the International Radio Consultative Committee.

JTC3A: Joint Tactical Command. Control and Communications Agency

Defense Communications Engineering Center
1860 Wiehle Avenue
Reston, VA

The JTC3A at Fort Monmouth, NJ, and Reston, VA, manages development and maintenance of tactical communication systems technical standards under the Military Standard-188 series program. They also prepare interface specifications for communication equipment to interoperate, conduct assessments of technology developments, and performs testing and certification of specific systems for use in combined operations.

The Center for Standards at Ft. Monmouth, NJ, was formed to coordinate a number of standards activities for the DoD. Since this center is still evolving, no organizational structure has been finalized but a proposed organization chart is shown under the section describing the Center for Standards. The JTC3A organization is under the Deputy Director for Defense Wide C3 support as shown in Figure A-19.

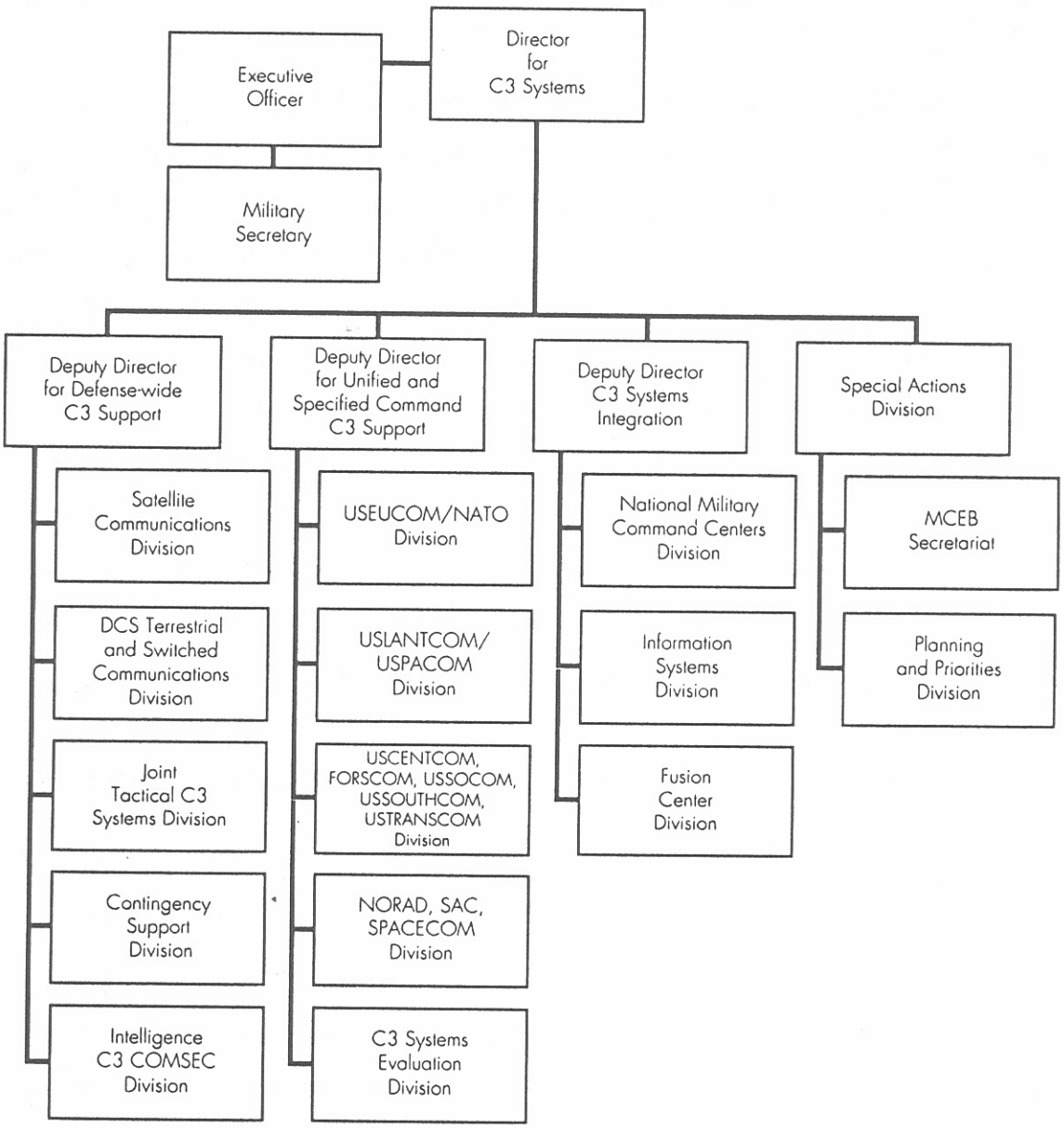


Figure A-19. Organization of the JTC3A.

NCS: National Communication System Office of Technology & Standards

Technical Standards Committee
8th Street and South Court House Road
Arlington, VA 22204

The National Communications System of the Federal Government was given the responsibility by the General Services Administration to develop Federal Standards in the area of telecommunications for the Federal Standardization Program. This activity is also supportive of the NCS mission, which is to organize the Federal telecommunications resources needed to support the U.S. in terms of national disaster. Interoperability, and therefore effective standardization, of Federal telecommunications is essential. Presently 25 Federal agencies and 30 private agencies are involved in NCS operations.

National Security and Emergency Preparedness (NS/EP) and the Federal Telecommunications Standards Program (FTSP) are two important functions assigned to the National Communication System with the Secretary of Defense as Executive Agent. The Secretary has designated the Director of DISA to serve concurrently as the Manager of NCS. The organizational structure is shown in Figure A-20.

Figure A-21 depicts the Office of the Manager, NCS. Under the manager are four subgroups for; the Joint Secretariat, Technology & Standards, Plans & Programs, and Emergency Preparedness. The FTSC falls under the Office of Technology & Standards (OTS).

NIST: National Institute of Standards and Technology

Technology Building 225
(or Building 255, Room B154 for NCSL)
Gaithersburg, MD 20899

Formerly known as the National Bureau of Standards, the National Institute of Standards and Technology (part of the U.S. Department of Commerce) has among its responsibilities the development of automatic data processing standards. This responsibility, established by the Brooks Act in 1965 (Public Law 89-306) and the Computer Security Act of 1987 (Public Law 100-235), is the basis for programs which seek to overcome barriers to the efficient use of computer systems, to achieve cost-effective exchange of information, and to protect valuable

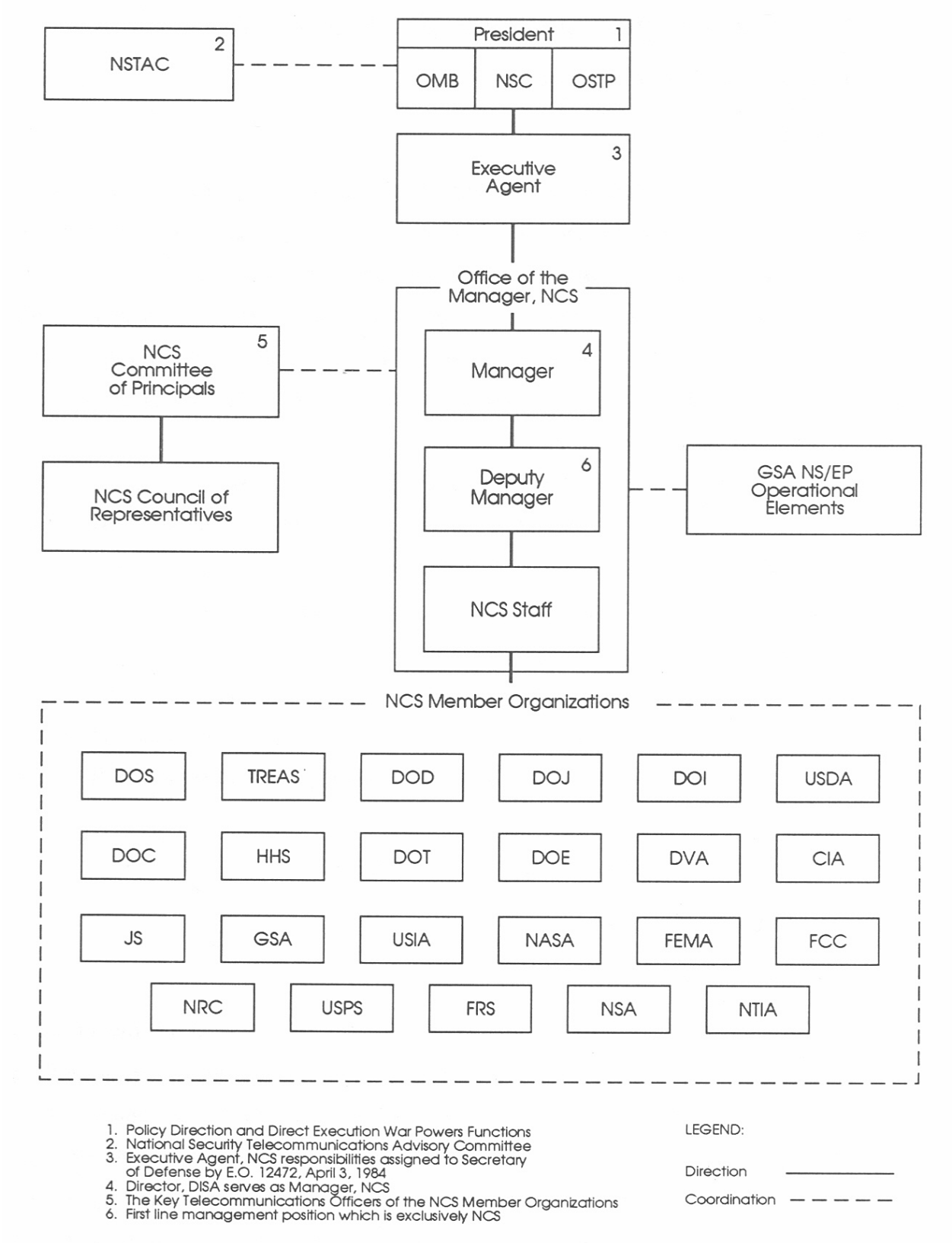


Figure A-20. Organization of the NCS.

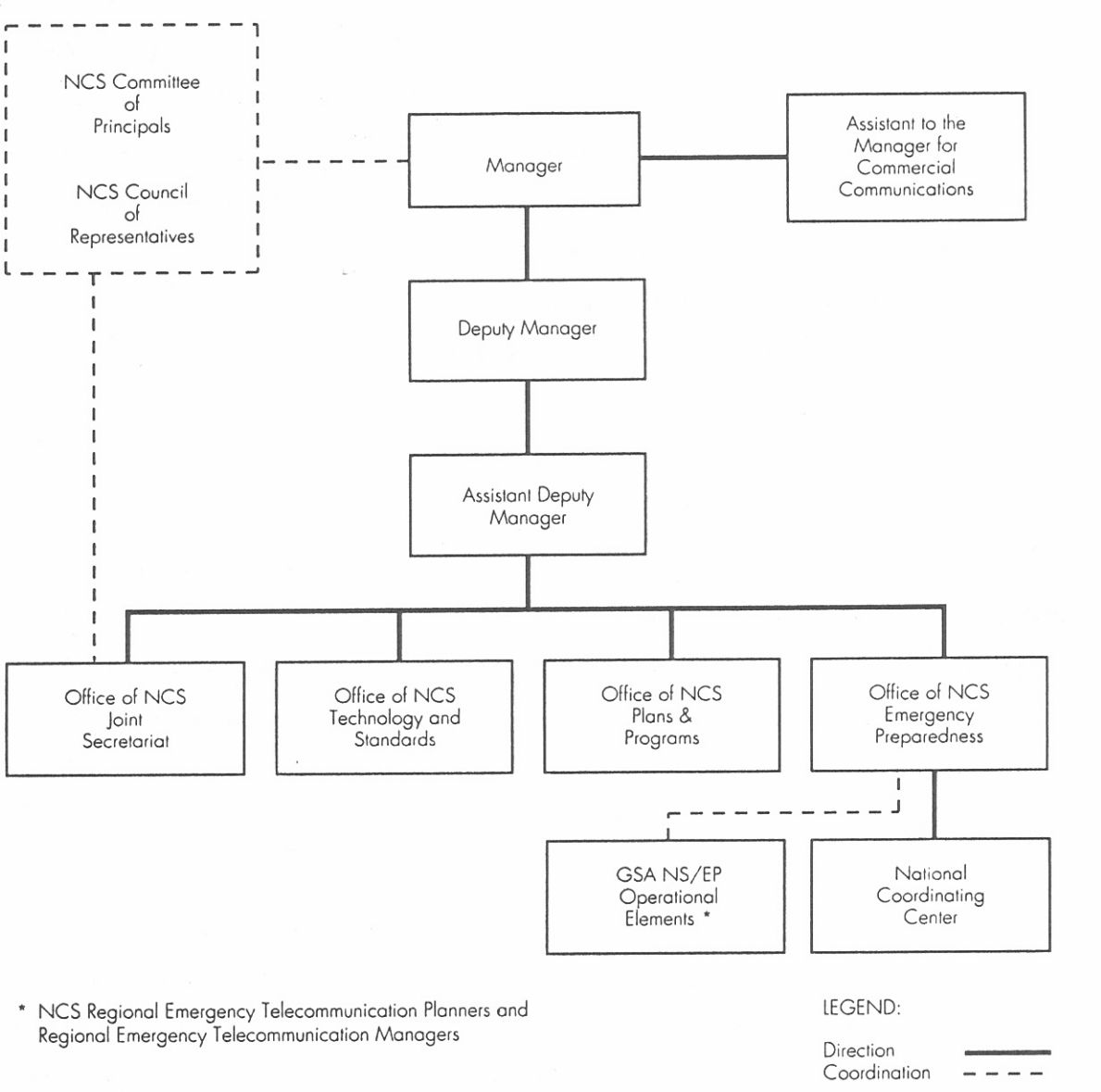


Figure A-21. Organization of the Office of the Manager, NCS.

information resources in computer systems (excluding classified and certain unclassified, national-security-related systems).

NIST staff members participate in a number of national and international standards organizations, including the ANSI X3 Committee on Information Processing Systems, ISO Technical Committee 97 on Information Processing Systems, CCITT, ECMA, and the IEEE. NIST also conducts Implementor Workshops and User Workshops to provide a means to incorporate input from users and vendors. For example, NIST develops implementations agreements for OSI in the OSI Implementation Workshop (OIW) and in special interest groups (SIGs). One such SIG is concerned with network management protocols. Specific NM options are selected and published as NM agreements.

The National Computer Systems Laboratory (NCSL), one of NIST's major science and engineering research components, administers the Federal Information Processing Standards (FIPS) program from which come the FIPS publications (FIPS PUBS). This program includes development of standards, test methods, performance measures, guidelines, and information documents as well as the conduct of research on computer and related telecommunications systems. Many of the FIPS are adopted as ANSI standards, and the FIPS PUBS serve as the ANSI specifications. Organizational structure for NCSL is shown in Figure A-22.

The NIST and NCSL focus primarily on helping federal agencies make effective use of computers and information technology. However, their products, services, and technical support are used widely by the private sector, as well.

A-4 EUROPEAN STANDARDS ORGANIZATIONS

The structure for comprehensive standardization in Europe is depicted in Figure A-23. This structure evolved in 1988 because the European Community (EC) became concerned with standards and recommendations from the European Conference of Posts and Telecommunications (CEPT) and the International Telegraph and Telephone Consultative Committee. The balanced structure shown in the figure must deal with a number of pressure groups including Standards Promotion and Application Group (SPAG) (composed of manufacturing firms), European Manufacturer User Groups (EMUG), and the European Workshop for Open Systems (EWOS).

As an example, neither CEPT nor CCITT standards had the power to eliminate nonconformance in the European common market scheduled for 1992. In the field of computers

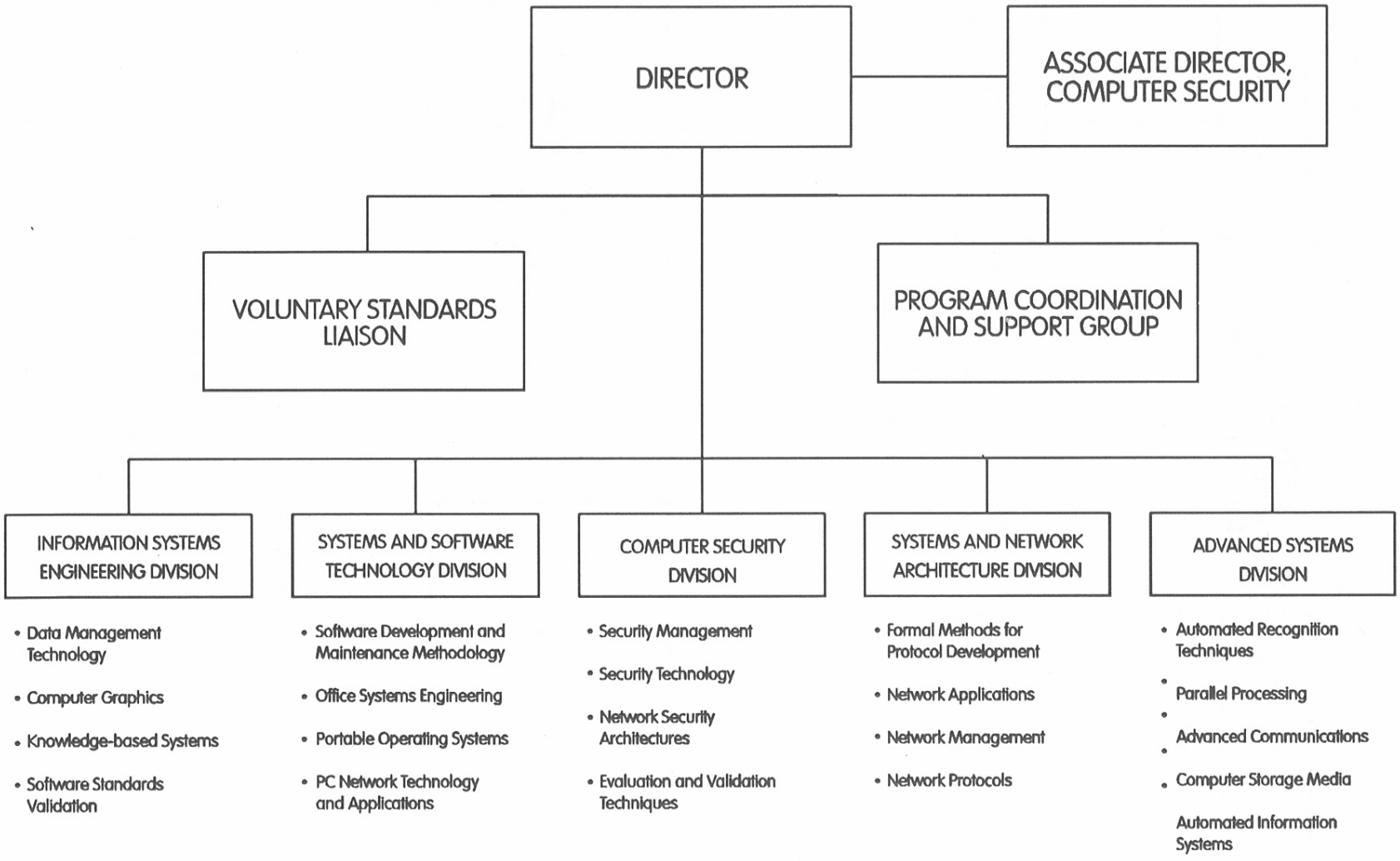


Figure A-22. Organization of the NCSL.

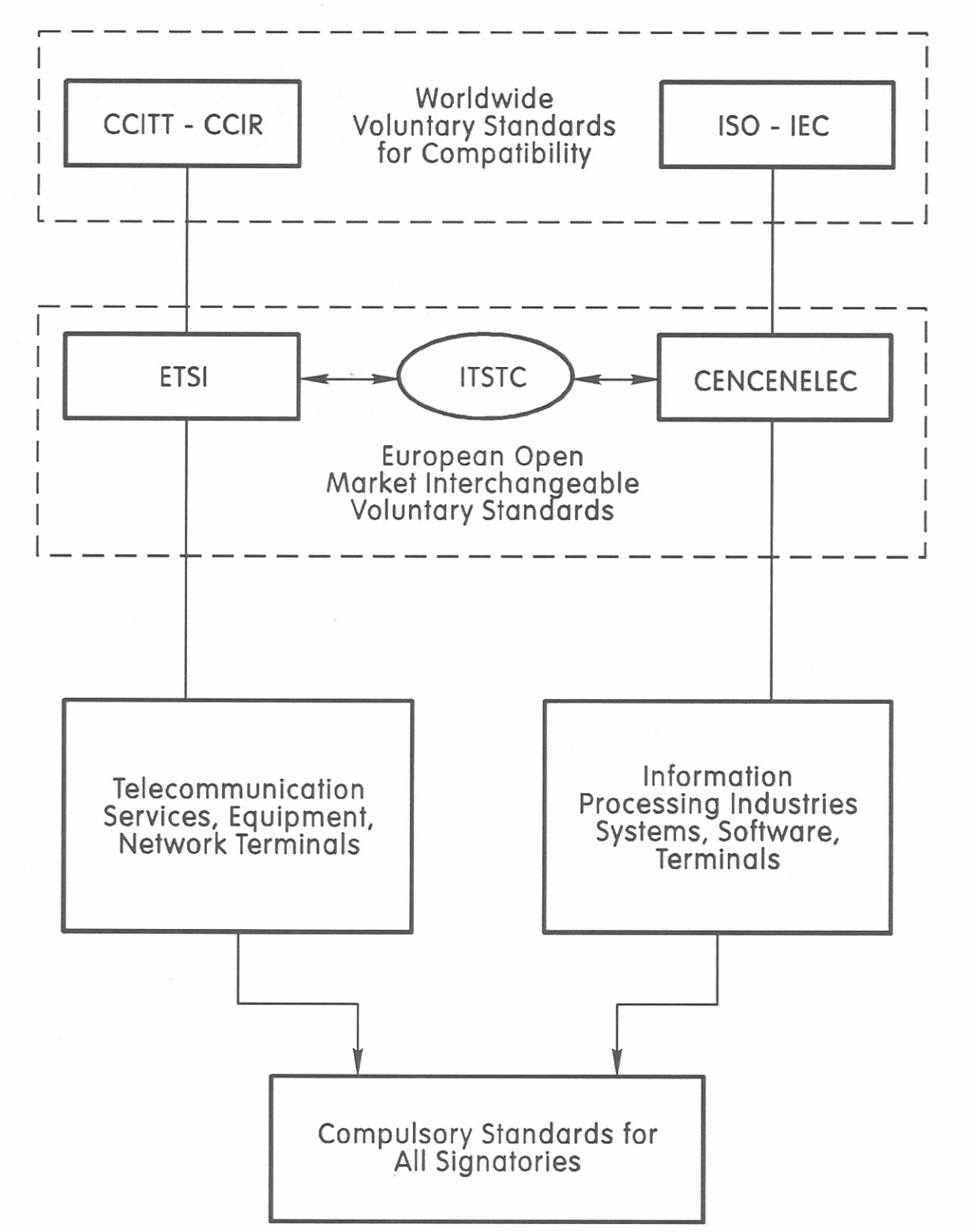


Figure A-23. Standards organizations in the European community.

and related terminals, the European committees CEN and CENELEC interacting with ISO and IEC used majority votes to decide controversial standards issues. In the field of telecommunications, however, both the CCITT and CEPT aimed for harmonization by unanimous acceptance. The ETSI performs the standards functions formerly the responsibility of CEPT. A weighted voting procedure is used to select standards that are binding on all members. These compulsory standards are known as NETS (Normes Europeannes des Telecommunications). The objective of NETS is economic, namely they are intended to exert control over the computer communication markets. Further information is given by Wallenstein (1990).

CEN-CENELEC: European Committee for Standardization (CEN) and the European Committee for Electrotechnical Standardization (CENELEC)

2 Rue Brederode, Suite 5, B-l000
Brussels, Belgium

These two organizations along with the European Committee for Post and Telecommunications have been responsible for developing and publishing European standards. CEN and CENELEC both interact with the ISO and the IEC respectively to make member standards into international standards in the field of computers and related terminals. CEPT used to be CEN's counterpart dealing with telecommunication standards and subsequently with the CCITT. However, the standards work of CEPT is now the province of ETSI which was formed to accelerate the standardization processes and to promote harmonization among various European telecommunication systems. (See Besen, 1990.)

ETSI: European Telecommunications Standards Institute

Director
BP52, F-06561
Valbonne Cedex, France

This organization was founded in 1988 to accelerate standardization and harmonization in the European telecommunications community. ETSI has assumed the standards function formerly performed by CEPT. The organizations structure involved weighted majority voting, diverse membership, and elimination of alternative standards. The ETSIs overall objective of accelerating standards development is supposed to provide the European community with a

standards suprastructure with service options--user terminals accessible throughout the European communities. Members are drawn from some 30 countries and include national administrations, public network operators, manufacturers, users, private service providers, and research bodies. A detailed description of ETSI is given by Besen (1990). Table A-11 lists the technical committees of ETSI. Cooperative agreements between ETSI, ANSI T1, CCITT, and the CCIR are described by Budway (1990).

Table A-11. Technical* Committees Established by ETSI Technical Assembly

Code Name	Field of Standardization	Chairman's Nationality
ATM	Advanced Testing Methods	Italy
BT	Business Telecommunications	Norway
EE	Equipment Engineering	Switzerland
GSM	Special Mobile Group	Sweden
HF	Human Factors	Germany
*IPR	Intellectual Property Rights	
*ISM	ISDN Standards Management	Germany
NA	Network Aspects	UK
PS	Paging Systems	Spain
RES	Radio Equipment and Systems	Germany
SES	Satellite Earth Stations	France
SPS	Signalling, Protocols, Switching	Sweden
*SRC	Strategic Review Committee	France
TE	Terminal Equipment	UK
TM	Transmission and Multiplexing	France

Author's Note: Blank space in last column indicates chairmanship is not known at time of publication.

*IPR, ISM, and SRC are Special Committees, established apart from the Technical Committees with clear-cut, standards-drafting assignments.

ITSTC: Information Technology Steering Committee

2 Rue Brederode, Suite 5, B-1000
Brussels, Belgium

This multinational organization, formed in 1985 and supported by CEPT, CEN, and CENELEC, has responsibility for coordinating European standardization efforts pertaining to the OSI Model. The ultimate objective is to develop interchangeable standards for the European open market.

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APPENDIX B: SUMMARY DESCRIPTION OF THE OSI REFERENCE MODEL

This Appendix presents a summarized description of the layered architectural model that has been standardized by the ISO and that is followed in developing standards and functional implementations. The layered architecture partitions the communications functions that occur between systems into multiple layers. Each layer adds to the services provided by lower layers. A layer defines the services that it must provide to the next higher layer using services from the layer beneath it but does not need to know the mechanism used to provide these services. Therefore, each layer's functions can be implemented independently of other layers. Each layer has a standard service specification that defines the services the layer provides. It also has a standard protocol specification that defines the format for information transfer between peer layers.

The seven-layer OSI model is illustrated in Figure B-1. Only recently have attempts been made to apply this layered concept to other networks. Narrative descriptions of the value-added services provided by protocols in each layer to the adjacent layer above are defined by Federal Standard 1037B (1991). They are as follows:

> **Physical Layer:** Layer 1, the lowest of seven hierarchical layers. The Physical Layer performs services requested by the Data Link Layer. The major functions and services performed by the Physical Layer are: (a) establishment and termination of a connection to a communications medium; (b) participation in the process whereby the communication resources are effectively shared among multiple users, e.g., contention resolution and flow control; and (c) conversion between the representation of digital data in user equipment and the corresponding signals transmitted over a communications channel.
>
> **Data Link Layer:** Layer 2. This layer responds to service requests from the Network Layer and issues service requests to the Physical Layer. The Data Link Layer provides the functional and procedural means to transfer data between network entities and to detect and possibly correct errors that may occur in the Physical Layer.
>
> **Network Layer:** Layer 3. This layer responds to service requests from the Transport Layer and issues service requests to the Data Link Layer. The Network Layer provides the functional and procedural means of transferring variable length data sequences from a source to a destination, via one or more networks while maintaining the quality of service requested by the Transport Layer. The Network Layer performs network routing, flow control, segmentation/desegmentation, and error control functions.

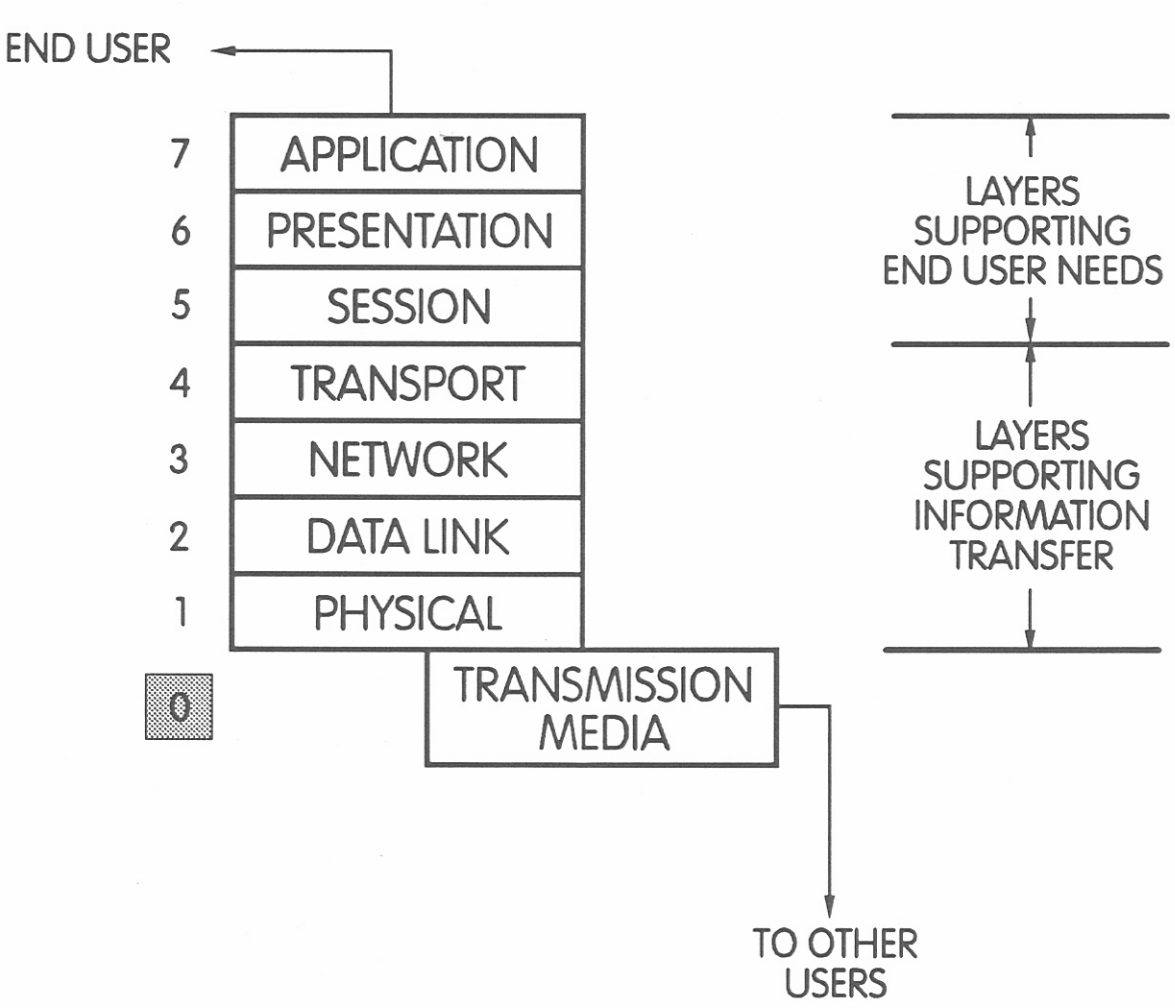

Figure B-1. Open system interconnection (OSI) protocol reference model.

Transport Layer: Layer 4. This layer responds to service requests from the Session Layer and issues service requests to the Network Layer. The purpose of the Transport Layer is to provide transparent transfer of data between end users, thus relieving the upper layers of any concern with providing reliable and cost-effective data transfer.

Session Layer: Layer 5. This layer responds to service requests from the Presentation Layer and issues service requests to the Transport Layer. The Session Layer provides the mechanism for managing the dialogue between end-user application processes. It provides for either duplex or half-duplex operation and establishes checkpointing, adjournment, termination, and restart procedures.

Presentation Layer: Layer 6. This layer responds to service requests from the Application Layer and issues service requests to the Session Layer. The Presentation Layer relieves the Application Layer of concern regarding syntactical differences in data representation within the end-user systems.

Application Layer: Layer 7. The highest layer. This layer interfaces directly to and performs common application services for the application processes; it also issues requests to the Presentation Layer. The common application services provide semantic conversion between associated application processes.

While the upper layers are embedded in the terminal software, the lower three layers are network-specific layers that support information transfer. Layer 1 assumes the existence of physical communication to other network elements as opposed to the virtual connectivity used by the higher layers. Some authors, e.g., Knightson et al. (1988), denote the transmission media itself including network topology as layer 0, since it is logically below layer 1 and is concerned with switch placement, concentrators, and lines, and what capacities to assign to the lines.

There is an abstract boundary between adjacent layers that is sometimes called an interface. This boundary separates functions into specific groupings. At each boundary, a service that the lower layer offers to its upper neighbor can be defined. Service providers are not required to physically implement access to these layer boundaries and may even merge layers. The important functional entities that must be transmitted are the protocols between peer-level layers. This protocol information is exchanged between network elements by appending it along with the final message in the sequence of transported bits (Appendix D). The implementation will conform to international standards when the protocol information that is transmitted between two layers of the local system and the corresponding layers of the communicating end systems is interpreted correctly by both systems.

The protocols within all layers define the networks' functional (or protocol) architecture. The specification of these protocols is needed to implement a service to an end user. Implementation of these protocols in hardware and software can be accomplished in many ways. Neither the details of the implementation nor the boundary services are part of this architecture. One major advantage of this layered architecture concept is that lower layer implementations can be replaced as technologies advance, for instance, when a fiber link replaces a coaxial cable. The only requirement being that the new implementation provide the same set of services to its adjacent upper layer as before.

The OSI model is currently being extended to ISDN as illustrated in Figure B-2, (CCITT, 1989b). The separation between control information, user information, and management information is shown using multidimensional user, control, and management planes. The control plane may be divided further into local control (LC) and global control (GC) planes. Each plane may be a full protocol layered process or may only be partially implemented for some services. The management function coordinates the activities of all the planes. Management standards for layered architectures currently are under development, as described in this report.

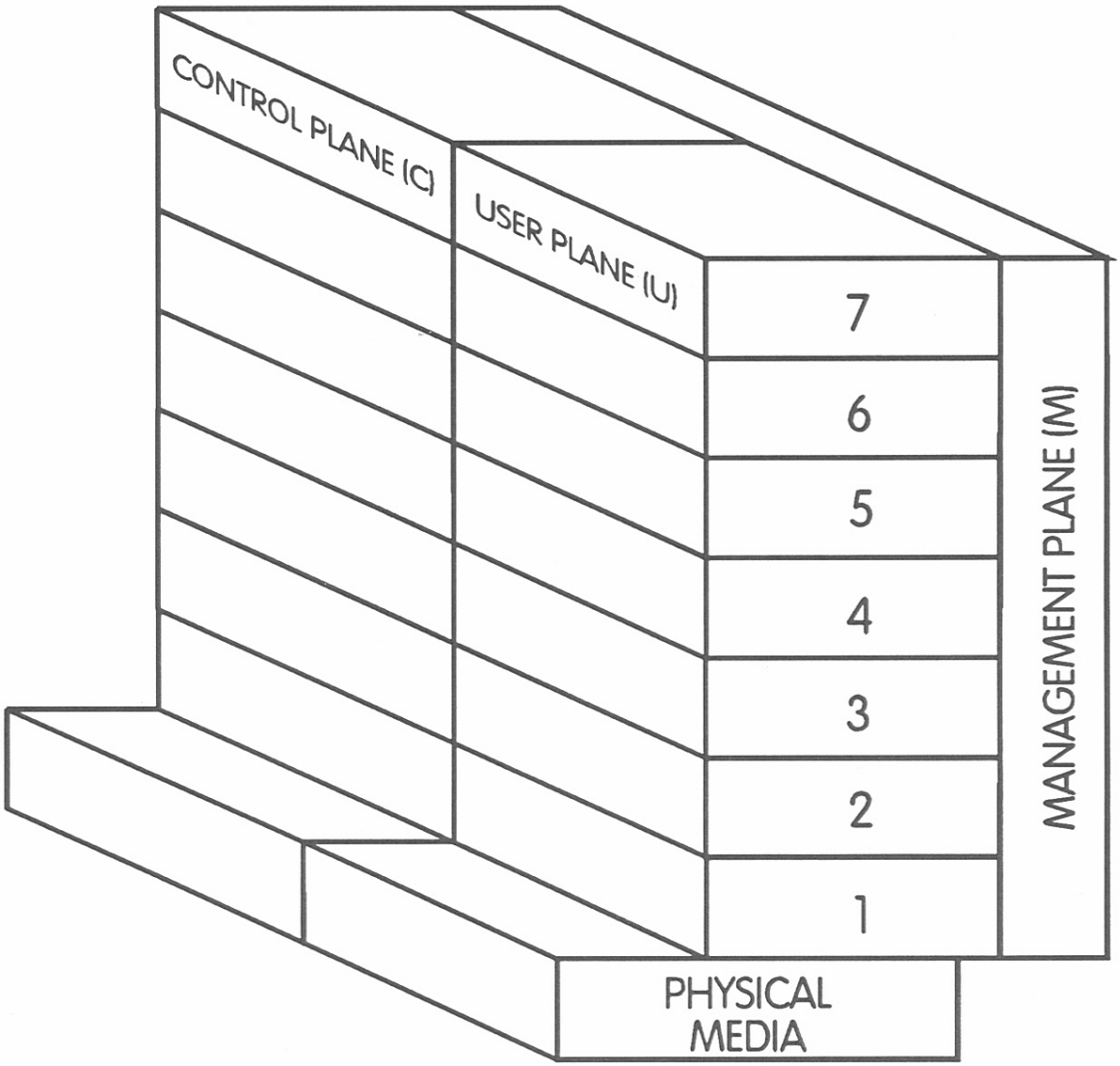

Figure B-2. Protocol reference model for ISDN.

APPENDIX C: LIST OF OSI NETWORK MANAGEMENT STANDARDS

OSI Management Framework

DIS 7498-4	Information Processing Systems - Open Systems Interconnection - Basic Reference Model - Part 4: Management Framework, April 1989.

Systems Management Overview

DP 10040	Information Processing Systems - Open Systems Interconnection - Systems Management Overview, June 1990.

CMIS/CMIP

DIS 9595	Information Technology - Open Systems Interconnection - Common Management Information Service Definition, January 1990.
DAD 1	Proposed Draft Addendum 1: Cancel Get Service
DAD 2	Proposed Draft Addendum 2: Add Remove Service
PDAM 4	Proposed Draft Amendment 4: Access Control
PDAM X	Proposed Draft Amendment X: Allomorphism
DIS 9596	Information Technology - Open Systems Interconnection - Common Management Information Protocol Specification, January 1990.
DAD 1	Proposed Draft Addendum 1: Cancel Get Protocol
DAD 2	Proposed Draft Addendum 2: Add Remove Protocol
PDAM P	Proposed Draft Amendment P: Protocol Implementation Conformance Statement
PDAM X	Proposed Draft Amendment X: Allomorphism
SC21 N5228	Proposed Technical Corrigenda to ISO 9595 and ISO 9596, July 1990.
SC21 N5232	Proposed Technical Corrigenda to ISO 9596, August 1990.

Systems Management

DIS 10164-1	Information Technology - Open Systems Interconnection - Systems Management - Part 1: Objective Management Function, May 1990.

DIS 10164-2	Information Technology - Open Systems Interconnection - Systems Management - Part 2: State Management Function, May 1990.
DIS 10164-3	Information Technology - Open Systems Interconnection - Systems Management - Part 3: Attributes for Representing Relationships, May 1990.
DIS 10164-4	Information Technology - Open Systems Interconnection - Systems Management - Part 4: Alarm Reporting Function, June 1990.
DIS 10164-5	Information Technology - Open Systems Interconnection - Systems Management - Part 5: Event Report Function, June 1990.
DIS 10164-6	Information Technology - Open Systems Interconnection - Systems Management - Part 6: Log Control Function, June 1990.
CD 10164-7	Information Technology - Open Systems Interconnection - Systems Management - Part 7: Security Alarm Reporting Function, May 1990.
CD 10164-8	Information Technology - Open Systems Interconnection - Systems Management - Part 8: Security Audit Trail Function, July 1990.
CD 10164-9	Information Technology - Open Systems Interconnection - Systems Management - Part 9: Objects and Attributes for Access Control, June 1990.
CD 10164-10	Information Technology - Open Systems Interconnection - Systems Management - Part 10: Accounting Meter Function, August 1990.
CD 10164-11	Information Technology - Open Systems Interconnection - Systems Management - Part 11: Workload Monitoring Function, July 1990.
SC 21 N4972	Information Technology - Open Systems Interconnection - Systems Management - Part m: Measurement Summarization Function, July 1990.
SC21 N4978	Information Technology - Open Systems Interconnection - Systems Management - Test Management Function, June 1990.
SC21 N4957	Information Technology - Open Systems Interconnection - Systems Management - Confidence and Diagnostic Test Classes, May 1990.

Structure of Management Information

DIS 10165-1	Information Technology - Open Systems Interconnection - Management Information Services - Structure of Management Information - Part 1: Management Information Model, June 1990.

DIS 10165-2 Information Technology - Open Systems Interconnection - Structure of Management Information - Part 2: Definition of Management Information, June 1990.

DIS 10165-4 Information Technology - Open Systems Interconnection - Management Information Services - Structure of Management Information - Part 4: Guidelines for the Definition of Managed Objects, June 1990.

SC21 N4960 Information Technology - Open Systems Interconnection - Management Information Services - Generic Managed Objects, June 1990.

SC21 N4971 Information Technology - Open Systems Interconnection - Accounting Management Working Document - Fourth Version, July 1990.

SC21 N4981 Information Technology - Open Systems Interconnection - Systems Management - Performance Management Working Document - Sixth Draft, July 1990.

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12. Type of Report and Period Covered

13.

14. SUPPLEMENTARY NOTES

15. ABSTRACT *(A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.)*

The objectives of this report are (1) to identify and examine various divergent perspectives that exist about the technology termed network management; (2) to develop a conceptual definition and understanding of network management that is rational and comprehensive; and (3) to examine the questions of what is involved in supporting and controlling a network, what is being done or needs to be done to provide that support and control, and who is involved in doing it. Consistent with these objectives, the report presents a conceptual explanation of network management that is admittedly idealistic, describes the many organizations that are actively involved with the development of real-world, network management standards, examines the functional characteristics of a variety of network management products (available in 1991/92), and discusses some of the important issues and trends that are creating new requirements for network management.

16. Key Words *(Alphabetical order, separated by semicolons)*

network management, network management systems, standards

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