THE FEDERAL TELECOMMUNICATION STANDARDS PROGRAM

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Abstract—The Federal Telecommunication Standards Program was initiated in 1972 to provide for the development and coordination of Federal telecommunication standards for National Communications System interoperability and computer-communication interface. This paper presents background information relating to the development of the program, its relationship with other standards organizations, and the potential impact of standards developed and being developed upon Government and industry. A summary of past and on-going standardization activities has also been included, together with commentary on future activities.

I. INTRODUCTION

Pursuant to the request of the Director of Telecommunications Policy, Executive Office of the President, the Administrator of the General Services Administration (GSA) on August 14, 1972 assigned the responsibility for the development of certain Federal Standards to the National Communications System (NCS) organization [1]. As a result of this action, the Federal Telecommunication Standards Program (FTSP) was established by the Manager, NCS. The purpose of this paper is to bring into focus the scope, objectives, participants, and method of operation of the FTSP in carrying out these responsibilities. To set the stage for this discussion it is necessary to provide general background information as to why the NCS was established, and what it is designed to accomplish.

II. BACKGROUND

President Kennedy established the NCS (see Fig. 1) on August 21, 1963 by Presidential memorandum [2]. His memorandum, triggered in part by interagency communications difficulties experienced during the Cuban missile crisis of 1962, directed the establishment of a National Communications System "to provide necessary communications for the Federal Government under all conditions ranging from a normal situation to national emergencies and international crises, including nuclear attack."

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The President appointed the Secretary of Defense as Executive Agent for the NCS, and directed that the NCS be established by linking together, improving, and extending on an evolutionary basis the communications facilities and components of the various Federal Agencies. The Director of the Defense Communications Agency was subsequently named Manager of the NCS as an additional responsibility. The agencies whose telecommunication resources comprise the NCS are as follows:

- Central Intelligence Agency
- Department of Commerce (NOAA)
- Department of Defense
- Department of the Interior
- Department of State
- Energy Research and Development Administration
- Federal Aviation Agency
- General Services Administration
- National Aeronautics and Space Administration
- United States Information Agency.

The agencies are categorized as either major or minor as shown in Figs. 2 and 3, respectively. This categorization is based principally upon the size of the telecommunication assets of one agency in relationship to the size of the other.

The NCS is, therefore, a confederation of the telecommunication facilities of the ten Federal agencies previously mentioned which, incidentally, comprise the bulk of the long-distance telecommunication resources of the Federal Government. The facilities continue to be funded and operated by the parent agencies to satisfy their respective mission requirements. They are, however, through joint planning, standardization, and other coordinated management activities of the NCS organization, available to satisfy national requirements transcending those of the individual agencies. The agency systems are responsive to the coordinated plans, programs, standards, and procedures developed by the Manager, NCS.

The objective is to ensure that the important Federal telecommunications resources are improved progressively, and can be operated so that the aggregate functions as a coherent system, both for the effective satisfaction of the most critical needs in emergency situations and for the effective and economical satisfaction of day-to-day tele-

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Fig. 1. NCS organizational chart.

communications needs of the Federal Government. In meeting this objective the NCS organization performs specific functions in the areas of emergency telecommunication planning, planning for communications support of the Federal Disaster Assistance Administration during disaster relief operations, administration of the NCS Circuit Restoration Priority System, coordination of NCS relevant telecommunication research and development programs, and management of the Federal Telecommunication Standards Program.

The NCS organization, in executing these functions, therefore serves as a focal point and catalyst for systematically tightening the bonds of this confederation of government telecommunication resources. The Federal Telecommunication Standards Program, which is addressed by this paper, with its emphasis on development of standards to facilitate interoperability of the NCS components networks, is clearly vital to the successful accomplishment of this particular aspect of the NCS mission.

Fig. 2. Major operating agencies.

III. FTSP SCOPE AND OBJECTIVES

The scope of the NCS's assignment under the Federal Standardization Program is presently limited to the development of Federal standards which either contribute to the interoperability of functionally similar Federal telecommunication networks or to achieving a compatible, efficient, and economical interface between such networks and appended computer terminals. In consonance with this assignment and with the NCS objective of improving the interoperability of its components networks, the objectives of the Federal Telecommunication Standards Program [3] may be stated as follows.

- 1) To develop the technical and procedural standards required to achieve operational compatibility among functionally similar telecommunication networks of the National Communications System.
- 2) To develop, in concert with the National Bureau of Standards, technical and procedural standards for data transmission and the computer-telecommunication interface.
- 3) To increase the cohesiveness and effectiveness of the Federal telecommunication community's influence on national and international standards programs, and on the Federal Information Processing Standards Program.

All standards emerging from the FTSP are coordinated and published in accordance with the provisions of the GSA-managed Federal Standardization Program and Federal Property Management Regulation 101-29.

IV. PROGRAM MANAGEMENT

The Manager, NCS, has overall responsibility for the FTSP. The day-to-day management of the program is accomplished by the Assistant Manager for NCS Technology and Standards, who also serves as Chairman of the Federal Telecommunication Standards Committee (FTSC). This committee consists of senior telecommunication experts from 14 different agencies as shown in Fig. 4. It should be noted that there are four agencies represented in addition to the NCS operating agencies.

The FTSC determines the relevance and priority of standardization project proposals, recommends positions which should be supported by Federal Government members of national and international standardization committees, and rules on the technical adequacy of draft Federal Telecommunication Standards for formal coordination with Government agencies and the private sector. The NCS Office of Technology and Standards also provides the chairman and members for a number of interagency, industry, national, and international standards committees engaged in identifying and developing standards which may be accepted in whole or in part as Federal Standards.

Standards evolving from the FTSP, which address purely telecommunication matters, are (following FTSC approval) forwarded through the Executive Agent, NCS, to the Director of Telecommunications Policy for policy approval and onward transmittal to GSA for publication. Standards involving the computer-telecommunication interface are subjected, in addition, to the approval of the Director of the National Bureau of Standards and the Secretary of Commerce.

All standards emerging from the FTSP are thoroughly coordinated with interested Federal agencies, and published in the Federal Register for industry and public comment prior to their approval by the FTSC.

V. PROGRAM THRUST

The major thrust of the FTSP, as well as the related industry, national, and international standardization efforts, is to achieve technical compatibility between future telecommunication systems. The NCS objective is to ensure, insofar as possible, that the interoperability-related standards are available for use when the design decisions must be made for each new NCS components network. No major effort is expended in the FTSP on the rather fruitless task of writing standards to resolve incompatibilities among the current in-place NCS networks. Such incompatibilities, of course, must be and have been identified as part of a continuous effort to enhance the quality of the data base used to support the emergency communication management

Fig. 3. Minor operating agencies.

responsibilities of the Manager, NCS. However, the design and use of appropriate interface conversion devices at selected interconnect points, rather than standardization, is usually found to be the most viable remedy for existing inter-network incompatibilities.

VI. OTHER STANDARDIZATION PROGRAMS

Due to the continued blurring of the line of demarcation between telecommunication and information processing systems, there is a considerable amount of interdependence between the FTSP and the Federal Information Processing Standards (FIPS) Program administered by the National Bureau of Standards (NBS). Recognizing this fact, the NCS organization and the National Bureau of Standards, at the outset of the FTSP in 1972, signed an agreement specifying which types of standards were exclusively telecommunications, which were information processing, and, most importantly, those types which must be developed as a joint undertaking. The essence of this agreement is depicted in Fig. 5. The NCS and NBS also concluded an agreement [3] signed by the Secretary of Commerce, the Director of the Office of Management and Budget, and the Director of Telecommunications Policy, specifying how standards projects falling into the category of a joint NBS/NCS

Fig. 4. Federal departments and agencies represented on the Federal Telecommunication Standards Committee.

responsibility were to be developed, coordinated, and published. It should be noted that three of the six standards already developed under the FTSP and four of the five proposed Federal Telecommunications Standards (FTS) awaiting publication fall into the joint FIPS/FTS category.

The relationship between the FTSP and the telecommunication-oriented voluntary standardization programs of the Electronic Industries Association (EIA), the American National Standards Institute (ANSI), the International Telecommunication Union (of which CCITT is part), and the International Standardization Organization (ISO) is best depicted by briefly summarizing the procedure followed in the development of Federal Standards 1020 and 1030.

The need for these two Federal Standards (describing the electrical characteristics of integrated circuit compatible balanced and unbalanced voltage digital interface circuits) was formally established by the Federal Telecommunications Standards Committee in October 1972. The essence of this need was the desire to use modern integrated circuit technology to greatly extend the distance over which high-speed or low-speed data could be economically transmitted on unloaded cable pairs without requiring the use of modems.

After completing a first draft of this standard, NCS and NBS representatives, knowing of the interest of the Electronic Industries Association in upgrading EIA Standard RS-232C, contacted EIA to determine its interest in developing the proposed new interface standard as a joint effort. The EIA responded affirmatively, and its Technical Committee TR30.1 undertook the development of EIA Standards RS-422 and RS-423, both of which were published in April 1975 and subsequently adopted by the Federal Government as Federal Standards 1020 and 1030.

During the development process, these standards, through NCS and EIA initiatives, were also introduced into the International Telegraph and Telephone Consultative Committee (CCITT), and compatible versions were finally adopted by CCITT in June 1974 as CCITT Recommendations X.27 and X.26, respectively. This illustrates the point that

the preferred means of developing a mandatory Federal standard under the FTSP is to stimulate the interest of existing voluntary national and international standards organizations in developing standards which will, as a by-product, help to solve the interoperability problems of functionally similar Federal telecommunication systems. Federal Government representatives on committees of other standards organizations help ensure that Government needs are met by commercial standards thereby enhancing the likelihood that Government procurement costs will be lower than for specially designed equipment.

This, it turns out, is not as difficult a feat as it appears at first glance, since one of CCITT's greatest concerns is the interoperability of the emerging new public data networks and their interface with computer terminals. In principle, our objectives are really quite similar, differing primarily in scale and operating policies.

VII. PROPOSED STANDARDS

Proposed Federal standards emerging from the FTSP fall into two categories: 1) Those standards which affect only Federal telecommunication systems and 2) those which affect both the telecommunication systems and information processing systems. Coordination of Category 1 standards is effected by formal letter to Federal departments and agencies which are significant consumers or providers of telecommunication services and by announcement of the proposed standard in the Federal Register (with a 90-day comment period).

Coordination of Category 2 standards is a considerably more complex procedure since it involves formal coordination with not only the Federal telecommunication community but also with all of the government "points of contact" under the Federal Information Processing Standards Program. Proposed Category 2 standards are likewise published in the Federal Register for comment and when completely coordinated and approved are published as both Federal Telecommunication Standards and Federal Information Processing Standards by GSA and NBS, respectively.

VIII. PUBLISHED STANDARDS

The following Federal standards have emerged from the FTSP since its initiation in October 1972.

: Federal Standard 1001 (FIPS PUB 37)—Telecommunications: High Speed Synchronous Signaling Rates Between Data Terminal Equipment and Data Communications Equipment.

: Federal Standard 1002—Telecommunications: Time and Frequency Reference Information in Telecommunication Systems.

: Federal Standard 1005—Telecommunications: Coding and Modulation Requirements for Nondiversity 2400 Bit/Second Modems.

: Federal Standard 1020 (FIPS PUB __*)—Telecommunications: Electrical Characteristics of Balanced Voltage Digital Interface Circuits.

: Federal Standard 1030 (FIPS PUB __*)—Telecommunications: Electrical Characteristics of Unbalanced Voltage Digital Interface Circuits.

: Federal Standard 1035—Telecommunications: Coding, Modulation, and Transmission Requirements for Single

<u>NBS EXCLUSIVE RESPONSIBILITIES (TELEPROCESSING)</u>	
1.	ADP EQUIPMENT, TECHNIQUES, AND COMPUTER LANGUAGES.
2.	DATA ELEMENTS AND CODES.
3.	PROMOTING DEVELOPMENT AND TESTING OF VOLUNTARY COMMERCIAL STANDARDS FOR ADP EQUIPMENT, TECHNIQUES, AND COMPUTER LANGUAGES AND THEIR ADOPTION AND IMPLEMENTATION AS FEDERAL STANDARDS WHERE APPROPRIATE.
<u>NCS EXCLUSIVE RESPONSIBILITIES (DATA TRANSMISSION)</u>	
1.	TRANSMISSION AND SWITCHING SYSTEMS (INCLUDING MODEMS).
2.	MANUAL OR AUTOMATIC OPERATING PROCEDURES OR DEVICES FOR SETTING UP, HOLDING, AND CLEARING CALLS USED FOR DATA TRANSMISSION IN FEDERAL SWITCHED NETWORKS.
<u>NCS/NBS MUTUAL RESPONSIBILITIES</u>	
1.	INTERFACE STANDARDS (DATA TERMINAL TO NETWORK).
2.	ALPHABETS AND CHARACTERS USED FOR TELEPROCESSING PURPOSES.
3.	ERROR DETECTION AND CORRECTION EQUIPMENT.

Fig. 5. Summary of mutual and exclusive responsibilities of the NCS and NBS for development of federal standards related to data transmission and teleprocessing.

Channel Medium and High Frequency Radiotelegraph Systems Used in Government Maritime Mobile Telecommunications.

Single copies of each of these standards are available at the GSA Business Service Centers in Boston, New York, Philadelphia, Atlanta, Chicago, Kansas City, Fort Worth, Denver, San Francisco, Los Angeles, and Seattle. They are also available from the National Technical Information System, Washington, DC. Information concerning the availability of FIPS PUBS is available from the Office of ADP Standards Management, National Bureau of Standards, Washington, DC 20234.

There are currently five Federal Standards awaiting publication, as follows.

: 1003—Telecommunications: Bit Sequencing of the American National Standard Code for Information Interchange in Serial-by-Bit Data Transmission.

: 1010 (FIPS PUB 16-1)—Telecommunications: Bit Sequencing of the American National Standard Code for Information Interchange in Serial-by-Bit Data Transmission.

: 1011 (FIPS PUB 17-1)—Telecommunications: Character Structure and Character Parity Sense for Serial-by-Bit Data Communication in the American National Standard Code for Information Interchange.

: 1012 (FIPS PUB 18-1)—Telecommunications: Character Structure and Character Parity Sense for Parallel-by-Bit Data Communication in the American National Standard Code for Information Interchange.

: 1013 (FIPS PUB 22-1)—Telecommunications: Synchronous Signaling Rates Between Data Terminal Equipment and Data Circuit-Terminating Equipment Utilizing 4 kHz Circuits.

The following Federal standards are currently under development, and are listed in order of their assigned Federal Standard numbers.

: 1004—Telecommunications: Heading Format Structure (Code Independent).

: 1006—Telecommunications: Coding and Modulation Requirements For 4800 Bit/Second Modems.

: 1007—Telecommunications: Coding and Modulation Requirements For 9600 Bit/Second Modems.

: 1020A—Telecommunications: Electrical Characteristics of Balanced Voltage Digital Interface Circuits.**

: 1026—Telecommunications: Data Encryption Standard (Telecomm Application).

: 1027—Telecommunications: Security Requirements for use of the Data Encryption Standard.

: 1030A—Telecommunications: Electrical Characteristics of Unbalanced Voltage Digital Interface Circuits.**

: 1031—Telecommunications: Interface between Data Terminal Equipment and Data Circuit-Terminating Equipment for Operation in Analog Telecommunications Networks.

: 1032—Telecommunications: Signal Quality for Digital Interface Circuits.

: 1033—Telecommunications: Digital Communication Performance Parameters.

: 1034—Telecommunications: Signaling and Supervisory Protocols for Federal Telephone System.

: 1037—Telecommunications: Glossary of Essential Terms and Definitions.

: 1040—Telecommunications: General Purpose Interface between Data Terminal Equipment and Data Circuit-Terminating Equipment for Synchronous Operation in Digital Telecommunication Networks.

: 1050—Telecommunications: Techniques for Protecting Federal Telecommunication Facilities from Damage by High Energy Electromagnetic Pulses (EMP).

: 1060—Telecommunications: Digital Facsimile Terminal Equipments.

: ————Telecommunications: Packet Switching.

The relationships between Federal Standards (existing and proposed), and Industry/National/International standards is summarized in Table I.

TABLE I

RELATIONSHIPS BETWEEN FEDERAL STANDARDS (EXISTING AND PROPOSED) AND INDUSTRY/NATIONAL/INTERNATIONAL STANDARDS

FED STD	FIPS	EIA STD	ANSI STD	ISO STD	CCITT RECOMM
1001	37				
1002					
1003	*		BSR X3.66	IS4335, IS3309	X.25 Level 2
1004	*		*	*	
1005					V.26/bis
1006					V.27 bis/ter
1007					V.29
1010	16-1		X3.15-1976		
1011	17-1		X3.16-1976		
1012	18-1		X3.25-1976		
1013	22-1		X3.1-1976		
1020	*	RS-422			X.27, VII
1020A		RS-427A			
1030	*	RS-423			X.26, V10
1030A		RS-423A			
1026			*		
1027					
1031	*	RS-449	*	*	*
1032	*				
1033					
1034					Sig Syst #6
1035					
1037				DIS 2382/ IX	
1040	*		*		X.21
1050					
1060		*			
Packet Sw	*		*	*	X.25

*Number not yet assigned.

**Updating of FED-STDs 1020 and 1030.

* Standard or Recommendation Number not assigned as of 10/18/77

IX. SUMMARY AND CONCLUSIONS

The Federal Telecommunication Standards Program is considered to be an effective tool for removing, through standardization, the significant technical impediments to operational compatibility among the next generation of Federal telecommunication systems, and to effect their efficient interface with information processing systems.

The program's emphasis on minimizing the differences between Federal, industry, national, and international standards also promotes the interoperability of Federal telecommunication systems with their national and international counterparts as well as enabling more Federal Government requirements to be satisfied by procurement of "off-the-shelf" equipment and services.

On the immediate horizon, the NCS and FTSC are focusing their attention on: 1) the activity underway in the EIA, ANSI, and the CCITT to develop terminal-to-network interface standards for packet switched systems, 2) the efforts of CCITT Study Group XI to develop a new common channel signaling system for use on "all digital" telephone transmission and switching networks, 3) the work of CCITT Study Group XIV to develop standards for digital facsimile equipments, and 4) development of a Federal Standard to implement for telecommunication applications the Data Encryption Algorithm, which was recently promulgated as FIPS PUB 46. In addition, a standardization project has been initiated to develop a series of Federal Standards to provide for the protection of Government telecommunications facilities from disabling damage due to EMP.

REFERENCES

- [1] Letter from Administrator, General Services Administration, to the Manager, National Communications System, Aug. 14, 1972, "Assignment of responsibilities for the development of Federal Telecommunication Standards."
- [2] Presidential Memorandum, Aug. 21, 1963, "Establishment of the National Communications System."
- [3] National Communications System Circular (NCSC 175-1), June 6, 1973, Federal Telecommunication Standards Program.

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