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MEMORANDUM

TO: Federal Departments and Independent Offices

SUBJECT: Application of Federal ADP Code and Media Standards

Enclosure 1: Approved Federal ADP Standards

Enclosure 2: Discussion of Probable Additional Federal ADP Standards

1. Introduction

Public Law 89-306 authorized the Secretary of Commerce to make appropriate recommendations to the President relating to the establishment of uniform Federal automatic data processing standards. The President, on March 11, 1968, approved as Federal Standards the "USA Standard Code for Information Interchange" (ASCII), as well as standards implementing the Standard Code in perforated tape and magnetic tape media. The announcement also delegated the responsibility of providing details on these standards and their application to the Secretary of Commerce.

2. Purpose

The purpose of this memorandum is to identify certain objectives, to relate the specific standards to these objectives, and to provide guidelines for application of these standards.

3. Objectives

The objectives of Public Law 89-306 are to provide for the economic and efficient purchase, lease, maintenance, operation and utilization (and reutilization) of automatic data processing equipment by Federal departments and agencies. The development, adoption and implementation of appropriate information processing systems standards contributes to these objectives through such benefits as:

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a. Improved cost effectiveness in the procurement and continued use of information processing systems and equipment including supporting software.

b. Extension of the economic benefits of automatic information processing through increased compatibility between and within systems, sharing of facilities between users, and simplified methods and procedures for the use of information processing facilities.

c. Increased freedom of selection of equipment which conform to compatibility standards and hence increased competition among suppliers of information processing equipment and supporting services.

A primary method of realizing these objectives is the provision of the highest practical degree of compatibility for the interchange of information in machine-processible form within and between information systems, including input/output equipment, source data automation equipment, other associated equipment, and communication systems. Included in these objectives is the maximum use of standard programming languages and a minimum need for reprocessing, reordering, or conversion of information in information processing operations. This compatibility objective is not limited to information processing within the Federal Government, but is to be extended, wherever practical, to interchange with other Governmental bodies, Government contractors, and others as appropriate.

A standard coded character set and standards which prescribe the method of representing the coded character set in media used for input/output purposes are basic requirements for compatible interchange of information in automatic information processing operations. It is becoming increasingly difficult to distinguish between information

which will always remain inside the originating installations and information which may now or later be needed elsewhere. Use of the same character set, code and media for installation files and interchange eliminates the need for such distinction.

It is the intention of the Federal ADP standards program that all installations ultimately adopt the ASCII based code, media and sequence standards for internal files. The speed of introduction will depend on the application mix and financial and personnel situation of the individual installation.

4. Standards Approved and Under Development

The specific code and media standards approved by the President in the March 11, 1968 memorandum are listed in Enclosure 1. Certain amplifying information on the additional recorded magnetic tape standards under development as well as potential additional Federal ADP standards processed in the USA Standards Institute is included in Enclosure 2. It can be expected that additional input/output media standards will be added to the list of Federal ADP standards as the work progresses. In some cases, a time delay following approval as a Federal standard, may be required for manufacturer conformance prior to their availability in equipment procurement.

5. Scope of Application

These guidelines apply to all computers and related equipment configurations brought into the Federal inventory and data systems developed for implementation by or for Government agencies on or after July 1, 1969. Related equipment includes all character oriented equipment in which magnetic tape or perforated tape is produced for input to a computer based data system or received for input from a computer based

data system. These guidelines also apply when transmission terminal equipment and facilities are procured primarily in support of a computer based data system.

6. Evolutionary Transition

Most of the computers and related equipment currently in use by the Federal Government are of a generation which pre-dated the approved Federal ADP standards. In view of the Government's investment in this equipment, the transition to these standards will be made on an evolutionary basis as equipment is replaced or added, computers reprogrammed and data systems redesigned. It is not the intention at this time to require the immediate conversion of existing data systems and equipment for the sole purpose of conforming to Federal ADP standards. Utilization of existing non-standard systems and equipments should be continued as long as economically advantageous.

For general guidance an agency which is currently entering into or planning a system conversion of any magnitude (new or more powerful hardware, machine independent software, remote-access operation, automatic data acquisition equipment for instance) should include in its plans not only the capability of use of the approved standards as prescribed by the President's memorandum, but a schedule for introduction of the code, media and collating sequence into external interchange and into internal files. While techniques for interchange should be given priority, implementation for data and program storage within installations and conversion of appropriate existing files should also proceed as rapidly as possible.

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Specifically, when interchange and internal file techniques are updated from Hollerith, Binary Code Decimal (BCD), pure binary and six-bit-oriented codes and media, the approved code and media standards should be applied. If the full character set of ASCII cannot be applied, the largest possible character subset of ASCII should be used, (see paragraph 10). In no case whatsoever should a non-standard code be adopted.

It is recognized that more efficient utilization of magnetic tape input/output facilities can be realized by the use of packing techniques (e.g. packed numerics and binary) in some types of operations. The use of these practices for local magnetic tape input/output operations is not precluded. However, character data will be recorded in the prescribed standards form when recording in other than in the packed mode in these local operations. Interchange between installations in packed modes may also be made by mutual agreement between sender and recipient.

7. Guidelines for Implementing the Standards

All computers and related equipment configurations brought into the Federal Government inventory on or after July 1, 1969 must have the capability to use ASCII and the formats prescribed by the magnetic tape and paper tape standards when these media are used.

In making the evolutionary transition to actual use of the approved standards, planning and implementation must be based on the environment in which the computers and related equipment configurations added to the inventory are to be used. Guidance is provided as follows:

a. Initial Acquisition Where there are no existing tape files or program libraries which prevent immediate use of the approved Federal standards, these standards should be fully implemented in new additions

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to the inventory and their use should be specified in the request for proposals. The supporting software should be compatible with the character set, code, media and collating sequence of the approved Federal standards.

b. Replacement of Computers and Related Equipment Configurations.

Actual use of the approved standards with replacement computers added to the inventory may be dependent upon reprogramming of the computer and file conversion. Such reprogramming and file conversion may be accomplished completely when the replacement becomes operational, particularly if the data system has undergone major revision. In this case, the standards should be fully applied upon conversion. If the reprogramming and file conversion is to be completed over a phased time period, the standards will come into use as the reprogramming and conversion is accomplished over the phased time period. Replacement equipment added to the inventory which does not require significant reprogramming effort should fully implement the approved standards wherever practicable. This may result in code conversion temporarily between older equipment retained in an installation where equipment is added which uses the approved standards. Such transitional incompatibilities are probably unavoidable in an evolutionary transition to standards.

c. Augmentation of an Existing Computer or Related Equipment Configuration. It is sometimes necessary to augment an existing computer installation with an additional computer or peripheral input/output equipment in which the added equipment must make use of the same media files as the older equipment. In this case, the use of the standards may have to be deferred until the entire system can be converted to the standards.

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New capabilities added to an existing installation or system, such as remote terminals or a source data acquisition subsystem should make use of the approved standards wherever practicable.

8. Interchange of Recorded Media Between Installations

One of the primary benefits to be derived from character set, code and input/output media standardization is improved ability to exchange information between installations of computers, and related equipment. The full benefits of standardization will be realized gradually as input/output equipment which use the standards replace the present inventory. The Federal standard (ASCII) character set and implementing input/output media standards will be used where information is interchanged between two installations that have standards conforming equipment. In many cases, it is expected that the standards can be used effectively for interchange between installations even though some or many of the installations involved do not use the standard media in their local information processing operations.

9. ADP - Telecommunications Interface

ASCII is also a standard for telecommunication networks. Some Federal telecommunications systems operate in ASCII, others will when updated in conformance with the National Communications System plans. Therefore, users of all computer systems and component acquisitions which will use Federal communications systems for the transmission of data should consult with the National Communication System as to the interface requirements.

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10. Character Set Size

The ASCII is a 7-bit code with 128 assigned characters of which 95 are graphic characters (including space). The use of both upper and lower cases of the alphabet is not required in many ADP, communication and related systems applications. Certain special purpose systems may require a very limited character set as, for example, a basic numeric set. In general, it is expected that equipment will have the capability of accommodating the entire ASCII code insofar as transmission and input/output from recorded media are concerned. Printing, keyboard generating and current computer software capability may, however, be more limited in some specific applications.

11. Extended Character Sets

A prime purpose in adopting the USA Standard Code as a Federal Standard is to provide for the use of a standard set of uniformly coded characters (graphics and control functions) in both computer based data systems and communication systems. The Standard Code prescribes 128 characters and the 7-bit code pattern assigned to each character. Means are provided in the Standard Code for extending the character repertoire of the 7-bit code. Specific methods of extension are defined in an additional proposed standard being processed by the USASI Standards Committee X3. The magnetic tape standard specifies the recording of the 7-bit Standard code in 7 information tracks with an additional (eighth bit) information track in which a "zero" is to be recorded for each character of the Standard Code. An additional 128 characters can, therefore, be uniquely coded on the magnetic tape by recording a "one" on the eighth-bit track. Hence, extended character sets can be represented in the 7-bit

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code by "extension" techniques and on magnetic tape by the "expansion" to 8-bits.

To prevent a proliferation of different characters and code assignments in "extended" and "expanded" sets, additional characters beyond the 128 in the 7-bit Standard Code will not be assigned by agencies until the planned assignments have been presented to, and approved by the National Bureau of Standards. This review will prevent uncontrolled character code assignment in larger sets which would lead to the same undesirable incompatibility that preceded the adoption of the Standard Code. NBS will maintain a register of approved character code assignments in extended character sets and, through its review of proposed assignments, will recommend compatible practices.

12. Waivers

The long-term compatibility and economic advantages obtained from the use of standards are expected to offset one-time conversion and transition costs of implementing approved standards. Except in very unusual circumstances, such one-time factors should not be used as a basis for granting exceptions. The heads of departments and agencies are authorized to waive application of these guidelines in those cases where both of the following conditions are applicable:

- a. Significant, continuing cost or efficiency disadvantages will be encountered by the use of ASCII and,
- b. The interchange of information with other systems is minimal and is expected to remain minimal.

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All exemptions and the reasons therefore will be coordinated with the National Bureau of Standards before they are authorized so that NBS may consider the impact of the decision on the standards program and the significance of the action with respect to future standards actions.

13. Additional Information

Questions related to these standards or their application as well as recommendations for revisions of these standards should be directed to the Center for Computer Sciences and Technology, National Bureau of Standards, Washington, D. C. 20234.

ENCLOSURE 1

Approved Federal ADP Standards

The specific standards approved by the President on March 11, 1968 are:

a. The USA Standard Code for Information Interchange, X3.4-1967, often abbreviated USASCII (sometimes as ASCII which is derived from its former title of American Standard). This standard defines the coded character set to be used for the general interchange of information among information processing systems, communication systems, and associated equipment.

b. The USA Standard Perforated Tape Code for Information Interchange, X3.6-1965, specifies the representation of the ASCII in perforated tape and similarly encoded media.

c. The USA Standard Recorded Magnetic Tape for Information Interchange, 800 CPI, NRZI; X3.22-1967, specifies the representation of the ASCII on 9-track, one half inch magnetic tape at a recording density of 800 characters per inch (CPI) using non-return to zero (NRZI) type recording.

This approved magnetic tape standard is one of a proposed family of three related magnetic tape standards being advanced within the USA Standards Institute (USASI) and the International Organization for Standardization (ISO). This 800 CPI Standard is the only one of the three that has advanced to final approval by the USASI. The other two members of the proposed magnetic tape family of standards included one of 200 CPI density and one of 1600 CPI density based on "phase encoding".

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ENCLOSURE 2

Additional Federal ADP Standards Under Development

The USA Standards Institute standards committees (X3 and X4) have been working on computer and information processing and related equipment standards for approximately eight years. The X3 Committee has produced 22 approved standards with a greater number in various stages of processing. Most of these are potential candidates as Federal ADP standards. These approved and proposed standards range through character sets, codes, media, transmission conventions, programming languages, vocabulary, problem analysis and data codes and data formats.

The Federal magnetic tape standard, 800 CPI, NRZI, identified in Enclosure 1 was stated to be one of a family of three recorded magnetic tape standards. The other two members of the family of magnetic tapes are:

(1) The proposed USA Standard Recorded Magnetic Tape for Information Interchange, 200 CPI, NRZI, which is intended to provide a relatively low performance tape for low-cost systems use, and

(2) The proposed USA Standard Recorded Magnetic Tape for Information Interchange, 1600 CPI, Phase Encoded, which is intended to provide a relatively high performance tape for use with systems where high performance can be used effectively. It is based on phase encoding in lieu of non-return to zero type recording.

All three members of the family are based on 9-track recording on one half inch magnetic tape. Action to adopt the two additional members of the related family of magnetic tape standards as Federal standards can be expected at the earliest practical date.

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A proposed USA Standard Magnetic Tape Label for Information Interchange was circulated to Government agencies for comment both as to its adoption as a USA standard and a Federal ADP standard. After slight revision its approval as a USA standard seems assured. It is also being processed in the final step as an ISO Recommendation. The standard label provides a standard method of describing the data format of the tape and should facilitate interchange of recorded magnetic tape reels.

The response of Federal agencies for the adoption of the proposed label standard as a Federal standard was generally favorable.

A proposed USA Standard Hollerith Punched Card Code was also circulated to Government agencies for comment on adoption as both a USA and Federal Standard. The response was quite favorable. This proposed standard is advancing in both the USA and ISO organizations. Approval as a Federal ADP standard appears warranted.

Work within an X3 Subcommittee (X3.2) is well advanced on a proposed standard edge punched card in which the ASCII code is punched along one edge of the card as on perforated tape. The proposed standard may offer significant economic advantages for use with low volume data transmission terminals since the format is the same as on perforated tape and code translation is not required as is the case with Hollerith coded cards.

Government agencies have also been queried on USA approved or proposed standards related to Optical Character Recognition, Data Transmission, Programming Language (COBOL) and keyboard. Follow-on work on some of these queries is still underway.

A data transmission control procedures proposal is nearing completion in an X3 Subcommittee (X3.3).

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Work is well advanced on code extension procedures for representing alternate sets of graphic and control characters with the standard code patterns via the use of the SO-SI (Shift Out - Shift In) and Escape characters of ASCII. Work is beginning on an "expanded" 8-bit code in which the 128 ASCII characters would be embedded in one half (lower half) of the 8-bit 256 position code table. This 8-bit code would be used with 8-bit processor presumably primarily as the "installation" code for I/O purposes.

Work is in early phases in Standards Committee X3 and X4 on computer to peripheral interfaces, on data elements and code standardization, all aspects of credit card standardization, and special purpose punched cards.

A number of Federal Government employees are participating in the development work on these standards. Most are probable candidates for adoption as Federal ADP standards.