

## X.400 Use of Extended Character Sets

### Status of this Memo

This RFC specifies an IAB standards track protocol for the Internet community, and requests discussion and suggestions for improvements. Please refer to the current edition of the "IAB Official Protocol Standards" for the standardization state and status of this protocol. Distribution of this memo is unlimited.

### 1. Introduction

Since 1988, X.400 has had the capacity for carrying a large number of different character sets in a message by using the body part "GeneralText" defined by ISO/IEC 10021-7.

Since 1992, the Internet also has the means of passing around messages containing multiple character sets, by using the mechanism defined in RFC-MIME.

This RFC defines a suggested method of using "GeneralText" in order to harmonize as much as possible the usage of this body part.

### 2. General principles

#### 2.1. Goals

The target of this memo is to define a way of using existing standards to achieve:

- (1) in the short term, a standard for sending E-mail in the European languages (Latin letters with European accents, Greek and Cyrillic)
- (2) in the medium term, extending this to cover the Hebrew and Arabic character sets
- (3) in the long term, opening up true international E-mail by allowing the full character set specified in ISO-10646 to be used.

The author believes that this document gives a specification that can easily accomodate the use of any character set in the ISO registry, and, by giving guidance rules for choosing character sets, will help interworking.

## 2.2. Families of character sets

### 2.2.1. ISO 6937/T.61

ISO 6937 is a code technique used and recommended in T.51 and T.101 (Teletex and Videotex service) and in X.500, providing a repertoire of 333 characters from the Latin script by use of non-spacing diacritical marks. It corresponds closely to CCITT recommendation T.61.

The problem with that technique is that the character stream comes in two modes, i.e., some characters are coded with one byte and some with two (composite characters). This makes information processing systems such as an E-mail UA or GW more complex.

It is also not extensible to other languages like Korean or Chinese, or even Greek, without invoking the character set switching techniques of ISO 2022.

### 2.2.2. ISO 8859

ISO 8859 defines a set of character sets, each suitable for use in some group of languages. Each character in ISO 8859 is coded in a single byte.

There are currently 11 parts of ISO 8859, plus a "supplementary" set, registered as ISO IR 154. Most languages using single-byte characters can be written in one or another of the ISO 8859 sets. There are sets covering Greek, Hebrew and Arabic, but there is still controversy over the problem of the rendering direction for Hebrew and Arabic.

All the ISO 8859 sets include US-ASCII as a subset. All use 8 bits.

ISO 8859 is regarded by many as a solution; for instance, the X windows system now comes with ISO-8859-1 as the "standard" character set, with the possibility of specifying others. But since the same applications often do not support character set switching within text, it is problematic to use these in a truly multilingual environment. (Also, most fonts claiming to be "ISO- 8859-1" in X11R5 are actually 7-bit fonts. The implied lie is very unfortunate.)

It turns out to work fine, however, if the second language is English, since this can be written in all ISO 8859 sets.

The parts 3 and 4 have not seen wide acceptance, and it is expected that they will be discarded. They should therefore not be used.

Note that an ISO 8859 set is actually 2 sets in the ISO sense: US-ASCII in the G0 set and another character set in the G1 set. The overloading of the word "character set" is unfortunate, but traditional.

### 2.2.3. ISO 10646

At the moment of writing, ISO 10646 has just been accepted as an International Standard. It is basically a 32-bit character set, with all of the currently used characters being numbered by the first 16 bits, leaving some room for expansion.

It is not possible to use ISO 10646 as a normal character set, because it does not conform to the rules for usage of byte values set down in ISO 2022 and other places; it uses the "control space" for (parts of) graphic character codes.

There are a number of ways to encode ISO 10646 characters "on the wire". There are methods within the ISO 2022 standard to switch to these, either as "other coding system without return" or as "other coding system with return" (that is, you can go back from it to the one you came from using an ISO 2022 escape sequence).

The following registrations have been made:

ISO 10646 UCS-2 Level 1 has been registered with ESC 2/5 2/15 4/0,  
ISO 10646 UCS-4 Level 1 has been registered with ESC 2/5 2/15 4/1,

The following are applied for:

Reg#	Escape sequence	Standard/Sponsor	Description
174	ESC 2/5 2/15 F	ISO/IEC 10646	UCS-2, Level 2
175	ESC 2/5 2/15 F	ISO/IEC 10646	UCS-4, Level 2
176	ESC 2/5 2/15 F	ISO/IEC 10646	UCS-2, Level 3
177	ESC 2/5 2/15 F	ISO/IEC 10646	UCS-4, Level 3
178	ESC 2/5 F	ISO/IEC 10646	UTF-1

<< NOTE: The registration numbers for UCS-2 level 1 and UCS-4 level 1 are not known. Neither are the assigned final characters for the other sets. Information requested!>>

This character set will become very important in the future, but at the moment, few systems are able to support this directly.

The GeneralText body part can be used for carrying any of these character sets.

### 2.3. Body parts that can be used in X.400

At the moment, no established way of transferring a full set of characters in X.400-based E-mail exists. In the future, it is likely that a new body part, based in ISO 10646, will be available, or GeneralText may be able to use ISO 10646, but this matter has not yet been clarified.

In the short term, the deployed and available body parts are:

- (1) IA5Text
- (2) For X.400/84: ISO6937Text and Teletex
- (3) For X.400/88: GeneralText

IA5Text is the method of choice for E-mail that contains only characters from IA5 (equivalent to US-ASCII).

The ISO6937Text body part is defined in the ISO DIS documents corresponding to X.400(84) [10]; these never became a standard, so they are now quite difficult to find. It is in principle limited to using text that can be presented in ISO 6937, but since ISO 6937 refers to the ISO 2022 method of changing character sets, it is theoretically possible to use any ISO registered character set, but there is no facility for announcing the character sets used. This makes interworking with equipment that does not support the same character sets complex.

It is still, however, the only body part suitable for carrying non-paginated text in non-basic character sets in X.400(84).

Teletex, which is identical in all versions of the X.400 standard, has the same problem of implicit ISO6937, but has the added problem that it also specifies a page format, with, for instance, a left margin of 5 character positions. This is often not desirable.

The details of Teletex are specified in recommendation T.51 and its relatives.

GeneralText is defined in ISO 10021-8, the part of [9] that corresponds to CCITT recommendation [11]. It is an Extended body

part, so no modification to CCITT implementations is needed to carry it.

GeneralText is suitable for interchange, since it has got proper announcement facilities. It can use any number of character sets, and announces them both in the Encoded Information Types of the X.400 envelope and the parameters of the body part.

We recommend this body part for carrying unformatted text in X.400/88.

### 3. GUIDELINES FOR THE GENERATION OF GENERALTEXT

#### 3.1. Formal definition of GeneralText

A GeneralText message is a byte stream that contains characters and character switching sequences according to [12].

The X.400 ASN.1 definition of the GeneralText body part is:

```
general-text-body-part EXTENDED-BODY-PART-TYPE
  PARAMETERS GeneralTextParameters IDENTIFIED BY id-ep-general-text
  DATA      GeneralTextData
  ::= id-et-general-text
```

```
GeneralTextParameters ::= SET OF CharacterSetRegistration
```

```
CharacterSetRegistration ::= INTEGER (1..32767)
```

```
GeneralTextData ::= GeneralString
```

The definition is from ISO/IEC 10021-7 [9], Annex I, with modifications made in the MHS Implementor's Guide, version 8, chapter 3.6.3, bullet F130. It does not appear in the CCITT version of the standards.

#### 3.2. Brief description of ISO 2022 character set switching

There are 4 graphic character sets active at any time in a GeneralText message, called G0, G1, G2 and G3. In addition, there are 2 control character sets, called C0 and C1.

At any moment, one of the sets G0-G3 is active in code positions 2/1 to 7/14, and another is active in code positions 10/0 to 15/15. The setting is achieved by so-called "locking shift" sequences.

(Formally, code positions 2/0 and 7/15 are reserved for "space" and "DEL" respectively, and only 94-character character sets can be used

in G0. In practice, this restriction is sometimes ignored)

Single characters from the non-active sets may be invoked by the use of "single shift" sequences.

The control character sets always occupy the code positions 0/0 to 1/15 (C0) and 8/0 to 9/15 (C1).

The character sets currently active as G0-G3 and C0-C1 may be changed using "character set designating sequences".

At the beginning of a GeneralText message, one must always assume that set 2 (IA5) is active as G0, shifted into the lower half, that set 1 (standard) is active as C0, and that no G1-G3 or C1 set is invoked. This is specified in the definition of "GeneralString" in [5], the definition of ASN.1 encoding (section 23.5.2).

If this is not a suitable initial state, a message must always start with the necessary announcers and escape sequences to designate and invoke the character sets that are actually used. The character sets in use may be changed later in the message by use of escape sequences.

The parameters of a GeneralText message always list all the character sets used, by quoting their ISO reference numbers.

It is impossible to use a character set not registered with ISO in a GeneralText message.

It is also impossible to decide on the true meaning of a byte in a GeneralText message without scanning the whole message for shift and escape sequences.

### 3.3. How to use the character sets

#### RECOMMENDATION:

When the text to be rendered is representable in one of the character sets of ISO-8859, the G0 set should be set to ISO 646 International Reference Version (1991), also called US-ASCII, ISO-IR-6.

The older character set ISO-IR-2, ISO 646 IRV(1983), should NOT be used. This means that the escape sequence ESC 2/8 4/2 (designating US-ASCII as G0) should always occur at the beginning of the message.

The G1 set should be set to the character set identified by the relevant ISO-8859 part. G2 and G3 are not used.

This corresponds to the first level of ISO 4873 usage.

For the currently defined parts of ISO 8859, the character set designations for the G1 set are (relative to ISO 8859:1987):

Part	ISO IR name	Escape sequence for G1 use	Remarks
1	ISO-IR-100	Esc 2D 41	West Europe (Latin-1)
2	ISO-IR-101	Esc 2D 42	East European (Latin-2)
3	ISO-IR-109	Esc 2D 43	(Latin-3)
4	ISO-IR-110	Esc 2D 44	(Latin-4)
5	ISO-IR-144	Esc 2D 4C	Cyrillic
6	ISO-IR-127	Esc 2D 47	Arabic
7	ISO-IR-126	Esc 2D 46	Greek
8	ISO-IR-138	Esc 2D 48	Hebrew
9	ISO-IR-148	Esc 2D 4D	Turkish (Latin-5)
10	ISO-IR-157	Not listed	Sami (Latin-6)

The escape sequence for 8859-10 (Latin-6) is not listed in RFC 1345.

NOTE: The use of ISO 8859-3 and ISO 8859-4 is NOT recommended if other possibilities exist.

NOTE: There is a debate about the Arabic and Hebrew character sets. These languages are normally read right to left, but encodings have been done in both "visual" (left to right) and "phonetic" (right to left) ordering, there is significant disagreement about what the "right" way to do it is, and the character sets mentioned do not specify it. So, one should be careful not to use these character sets until a standard is agreed upon, or the result will probably be unreadable (siht ekil).

(Note that there is some confusion as to what parts are actually standardized; the Norwegian standards institute reports that only part 1, 2, 3, 4, 6, 7 and 8 are currently standards. Other reports claim that both 8859-10 and 8859-11 are standards, and I definitely think that 8859-9 is.)

NOTE: ISO has not ruled out the possibility of changing the ISO 8859 standard. This would involve changing the registry information in this table, so this should be assumed valid for ISO 8859 versions that are current in 1993.

The G1 set should be permanently shifted into the upper half of the code page.

When the text is not representable in one of the ISO-8859 character sets, the following rules may be applied:

- (1) If any Latin characters are used, keep IA5 as the G0 set.
- (2) If a mainstream character set is used (Greek, Cyrillic, Hebrew, Arabic), designate this as the G1 character set, and permanently shift this into the upper half of the code page (LS1R).  
EXCEPTION: The Japanese community has a long tradition of switching between the Japanese 16-bit character set ISO-IR-87 and US-ASCII as the G0 set. See [7] for details. If ISO-IR-87 is used, that technique should be used instead of the one recommended here.
- (3) If occasional extensions to a character set that is basically Latin occur (like accents, national variants and so on), and these are available in a single character set, designate the relevant set as G2 and use single shift (SS2) to invoke characters from this character set.

The ISO 8859 supplementary set, ISO-IR-154, is recommended for this purpose.

This corresponds to the ISO 4873 "second level" application.

- (4) If two non-Latin character sets are used, the second should be designated as G3, and shifted into the upper half of the code page by the use of Locking Shift 3 Right (LS3R).

This corresponds to the ISO 4873 "third level" application.

- (5) If avoidable, use of character sets with floating accents, like ISO 6937, should be avoided.
- (6) The shifts changing the lower half of the code table (SI/SO, LS2 and LS3) should NOT be used.

RATIONALE: Keeping the G0 set reserved for US-ASCII will ensure that text in US-ASCII has the same bit representation always.

The use of the upper code page for other scripts ensures that both text in these languages and text of this type mixed with English can be represented without the use of shift sequences.

If the language and/or content of a text is completely unknown, chapter 5 gives an algorithm that may be used to decide upon the character sets. This might, for instance, be suitable for use at

automatic mail gateways.

NOTE: At the time of this writing, few applications that use ISO 4873 level 2 and level 3 encoding exist. It has been estimated that implementing them in an application that already uses a rich repertoire of characters is a matter of programmer-days, not programmer-months, but this has not been proven.

#### 4. GUIDELINES FOR THE RENDERING OF GENERALTEXT

As a basic rule, one should NOT assume that any of the rules above are followed.

An user agent capable of rendering GeneralText should:

- (1) ALWAYS be able to identify and render characters in IA5, no matter how they are designated and invoked.
- (2) ALWAYS be able to identify and render characters in the "native" character sets, no matter how they are designated and invoked.
- (3) ALWAYS indicate the presence of characters that cannot be adequately represented on the current output device.
- (4) NEVER render a character in an unknown or unrepresentable character set by displaying the character in the same bit position in the native character set.
- (5) PREFERABLY be able to identify and render characters that are the same as characters in the "native" character sets, even though they are designated and invoked as part of other character sets. This applies in particular to the "invariant" part of ISO 8859, parts 1 through 6.
- (6) PREFERABLY be able to combine the floating accents of ISO 6937 with their base characters for suitable rendering using the capabilities of the current output device.
- (7) PREFERABLY be able to display text both in a mode using fallbacks for nonrenderable characters and in a mode designating nonrenderable characters as such.
- (8) PREFERABLY be able to save the content of a GeneralText message to a file or other suitable media, saving all character set information, for later processing by other means. It is not illegal to render the character set information into a different format; however, it should be

noted that it is easy to lose vital information if the format chosen for representing character sets does not offer the possibility of referencing all character sets in the ISO registry of character sets.

These requirements also apply to gateways that transform the message into some other format, for example a gateway that transforms a message into MIME using [7] for the purpose.

## 5. RECOMMENDATION FOR SELECTION OF CHARACTER SETS

### 5.1. Algorithm for selection of character sets

When one has text in which characters from several character sets occurs, and wants to process this into a GeneralText document, it is often hard to guess right at the character sets to select.

The following paragraphs give an algorithm that can be started at the beginning of a message, and at the end of it, return a set of character sets that can be used as G0..G3 character sets, OR an indication that the task is impossible.

#### VARIABLES:

##### UsedSets

The set of character sets that MUST be used for this message

##### UsableSets

The set of character sets that MAY be used for this message.  
Each set also contains a counter for each character position.

##### PossibleSets

The set of all the character sets known to be usable in the destination format.

#### ALGORITHM:

- 1) Add IA5 (ISO-IR-6) to the UsedSets (as G0).
- 2) Get the next character of the text. If the text is completely analyzed, go to FINISHED
- 3) If it is in the UsedSets, go to 2).
- 4) Find the set of character sets from PossibleSets in which the character occurs. If it does not occur in any, report failure.

- 5) If it is in a single character set in PossibleSets only, add this set to UsedSets, and go to 2).
- 6) If it is in more than one character set, add these to PossibleSets (if not already present), and increment the counter for that character in all the sets. Go to 2).

FINISHED)

- 1) (FINAL SELECTION) Remove any character set in UsedSets from PossibleSets.

Zero the counters for any character in PossibleSets that also occurs in UsedSets.

WHILE (more characters left)

    Select one character set and move it from PossibleSets to UsedSets.

    Zero the counters for all characters in this set in the other PossibleSets.

END WHILE

This step can be "tuned" any way you want, for instance by choosing the character sets most likely to be understood at the destination first, choosing the character sets covering the most characters first, avoiding multi-byte character sets as long as possible, or any other scheme suitable for the application.

## 5.2. WHAT TO DO ON FAILURE

Failure will occur in this schema if a character is found that is not in the PossibleSets. It may then be handled in one of the following ways:

- (1) Replace the character with the SUB control character
- (2) Replace the character with Keld Simonsen Mnemonics [8]. This is a reversible transformation as long as the recipient is aware that it has been used, but requires passing out-of-band information to indicate this.
- (3) Replace the lost characters with any suitable fallback or mnemonic scheme intended for human understanding
- (4) Bounce the message/refuse the conversion/give up.

The action to be taken may be different based on the percentage of "lost" characters.

If the message has "controls" like "conversion with loss prohibited", only the last possibility may be used.

### 5.3. RECOMMENDED CHARACTER SETS

There are 2 steps in the algorithm above that are left for local judgement:

- (1) Selection of the sets to appear in PossibleSets.
- (2) The algorithm for deciding which character set to select in step 9.

In the context of generating X.400 GeneralText messages, the following is recommended:

Sets in PossibleSets:

ISO-IR-6	Esc 28 42 (G0)	US-ASCII, IA5, ISO646
ISO-IR-100	Esc 2D 41 (G1)	ISO-8859-1 West Europe
ISO-IR-101	Esc 2D 42 (G1)	ISO-8859-2 Central/Eastern Europe
ISO-IR-144	Esc 2D 4C (G1)	ISO-8859-5 Cyrillic
ISO-IR-127	Esc 2D 47 (G1)	ISO-8859-6 Arabic
ISO-IR-126	Esc 2D 46 (G1)	ISO-8859-7 Greek
ISO-IR-138	Esc 2D 48 (G1)	ISO-8859-8 Hebrew
ISO-IR-148	Esc 2D 4D (G1)	ISO-8859-9 Turkish

The following multi-byte character sets are recommended:

ISO-IR-87 (Japanese JIS C6226-1983)	Esc 24 29 42 (G1)
ISO-IR-149 (Korean KS C 5601-1989)	Esc 24 29 43 (G1)
ISO-IR-58 (Chinese GB 2312-80)	Esc 24 29 41 (G1)

It is a STRONG recommendation that character sets not listed above, which do not add any new characters to the total set of characters given by the character sets above, should NOT be used in X.400 interchange.

ISO-IR-87 is the Japanese character set that is allowed in a Teletex string, such as the subject field.

NOTE: ISO-IR-87 has been "superseded" by ISO-IR-168, which allows two extra Kanji characters. Any application that handles ISO-IR-87 should also be able to handle ISO-IR-168.

Algorithm for selecting character sets:

Start at the top of the list above, and add each set only if it is needed.

## 6. REFERENCES

- [1] Information technology - ISO 8-bit code for information interchange - Structure and rules for implementation, Third edition, 1991-12-15.
- [2] Information technology - 8-bit single-byte coded graphic character sets (parts 1-11; the parts have different dates, the ones referenced here are from RFC 1345).
- [3] Information technology - Coded graphic character set for text communication (parts 1 and 2; part 2 dated 1983-12-15).
- [4] Code for the representation of names of languages. 1988 version.
- [5] CCITT Recommendation X.209(1988): Specification of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1). Technically aligned with ISO 8825 and ISO 8825/AD 1.
- [6] Information Technology - Universal Multiple-Octet Coded Character Set (UCS) - ISO 10646.
- [7] Murai, J., Crispin M., and E. van der Poel, "Japanese Character Encoding for Internet Message Bodies", RFC 1468, Keio University, Panda Programming, June 1993.
- [8] Simonsen, K., "Character Mnemonics & Character Sets", RFC 1345, Rationel Almen Planlaegning, June 1992.
- [9] Information Technology - Text communication - Message- Oriented Text Interchange Systems (MOTIS) - ISO 10021 - October 1988.
- [10] ISO DIS documents describing X.400/84 with slight extensions. Now very hard to get copies of, since they failed to become ISes.
- [11] CCITT Recommendation X.420 (1988), Interpersonal Messaging System.
- [12] International Standard--Information Processing-- ISO 7-bit and 8-bit coded character sets--Code extension techniques, ISO 2022:1986.

## 7. Security Considerations

Security issues are not discussed in this memo.

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