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Paul Hoffman
IMC & VPNC
Marc Blanchet
ViaGenie

Stringprep Profile for Internationalized Host Names

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Abstract

This document describes how to prepare internationalized host name parts in order to increase the likelihood that name input and name comparison work in ways that make sense for typical users throughout the world. This profile of the stringprep protocol is used as part of a suite of on-the-wire protocols for internationalizing the DNS.

1. Introduction

This document specifies processing rules that will allow users to enter internationalized host name parts in applications and have the highest chance of getting the content of the strings correct. It is a profile of stringprep [[STRINGPREP](#)].

This document was previously called "nameprep" before splitting the structure of the protocol off into the stringprep document.

This profile defines the following, as required by [[STRINGPREP](#)]

- The intended applicability of the profile: internationalized host name parts
- The character repertoire that is the input and output to stringprep: defined in [Section 2](#)

- The list of unassigned code points for the repertoire: defined in [Appendix F](#).
- The mappings used: defined in [Section 3](#).
- The Unicode normalization used: defined in [Section 4](#)
- The characters that are prohibited as output: Defined in [section 5](#)

[1.2](#) Terminology

The key words "MUST", "SHALL", "REQUIRED", "SHOULD", "RECOMMENDED", and "MAY" in this document are to be interpreted as described in [RFC 2119](#) [[RFC2119](#)].

Examples in this document use the notation for code points and names from the Unicode Standard [[Unicode3.1](#)] and ISO/IEC 10646 [[ISO10646](#)]. For example, the letter "a" may be represented as either "U+0061" or "LATIN SMALL LETTER A". In the lists of prohibited characters, the "U+" is left off to make the lists easier to read. The comments for character ranges are shown in square brackets (such as "[SYMBOLS]") and do not come from the standards.

[2](#). Character Repertoire

Unicode 3.1 [[Unicode3.1](#)] is the repertoire used in this profile. The reason Unicode 3.1 was chosen instead of a version of ISO/IEC 10646 is that ISO/IEC 10646 is expected to be updated soon after this document becomes an RFC. Unicode 3.1 has the exact repertoire that is expected in the next version of ISO/IEC 10646, and is therefore used here.

[3](#). Mapping

This profile specifies stringprep mapping using the mapping table in [Appendix D](#). That table includes all the steps described in this section.

Note that text in this section describe how [Appendix D](#) was formed. It is there for people who want to understand more, but it should be ignored by implementors. Implementations of this profile MUST map based on Appendix D, not based on the descriptions in this section of how Appendix D was created.

[3.1](#) Mapped out

The following characters are simply deleted from the input (that is,

they are mapped to nothing) because their presence or absence should not make two strings different.

Some characters are only useful in line-based text, and are otherwise invisible and ignored.

```
00AD; SOFT HYPHEN
1806; MONGOLIAN TODO SOFT HYPHEN
200B; ZERO WIDTH SPACE
FEFF; ZERO WIDTH NO-BREAK SPACE
```

Variation selectors and cursive connectors select different glyphs, but do not bear semantics.

```
180B; MONGOLIAN FREE VARIATION SELECTOR ONE
180C; MONGOLIAN FREE VARIATION SELECTOR TWO
180D; MONGOLIAN FREE VARIATION SELECTOR THREE
200C; ZERO WIDTH NON-JOINER
200D; ZERO WIDTH JOINER
```

[3.2](#) Case mapping

The input string is case folded according to [\[UTR21\]](#). For most characters, this is the same as changing the input character to a lowercase character. For some characters, however, more complex transformations occur. The "CaseFolding.txt" file from the Unicode database was used to prepare the mapping table.

There are some characters that do not have mappings in [\[UTR21\]](#) but still need processing. These characters include a few Greek characters and many symbols that contain Latin characters. The list of characters to add to the mapping table were determined by the following algorithm:

```
b = NormalizeWithKC(Fold(a));
c = NormalizeWithKC(Fold(b));
if c is not the same as b, add a mapping for "a to c".
```

Because `NormalizeWithKC(Fold(c))` always equals `c`, the table is stable from that point on. The "DerivedNormalizationProperties.txt" file from the Unicode database was used to prepare [Appendix D](#). This mapping was added to reduce the number of processing steps, that is, to avoid doing case mapping and normalization twice.

[4](#). Normalization

This profile specifies using Unicode normalization form KC, as described in [\[UAX15\]](#).

[5](#). Prohibited Output

This profile specifies using the prohibition table in [Appendix E](#).

Note that the subsections below describe how [Appendix E](#) was formed. They are there for people who want to understand more, but they should be ignored by implementors. Implementations of this profile MUST map based on [Appendix E](#), not based on the descriptions in this section of how Appendix E was created.

The collected lists of prohibited code points can be found in [Appendix E](#) of this document. The lists in [Appendix E](#) MUST be used by implementations of this specification. If there are any discrepancies between the lists in [Appendix E](#) and subsections below, the lists in [Appendix E](#) always takes precedence.

Some code points listed in one section would also appear in other sections. Each code point is only listed once in the tables in [Appendix E](#).

[5.1](#) Space characters

Space characters would make visual transcription of URLs nearly impossible and could lead to user entry errors in many ways.

0020; SPACE
00A0; NO-BREAK SPACE
1680; OGHAM SPACE MARK
2000; EN QUAD
2001; EM QUAD
2002; EN SPACE
2003; EM SPACE
2004; THREE-PER-EM SPACE
2005; FOUR-PER-EM SPACE
2006; SIX-PER-EM SPACE
2007; FIGURE SPACE
2008; PUNCTUATION SPACE
2009; THIN SPACE
200A; HAIR SPACE
202F; NARROW NO-BREAK SPACE
3000; IDEOGRAPHIC SPACE

[5.2](#) Control characters

Control characters (or characters with control function) cannot be seen and can cause unpredictable results when displayed.

0000-001F; [CONTROL CHARACTERS]
007F; DELETE
0080-009F; [CONTROL CHARACTERS]
070F; SYRIAC ABBREVIATION MARK
180E; MONGOLIAN VOWEL SEPARATOR

2028; LINE SEPARATOR
2029; PARAGRAPH SEPARATOR
206A-206F; [CONTROL CHARACTERS]
FFF9-FFFC; [CONTROL CHARACTERS]
1D173-1D17A; [MUSICAL CONTROL CHARACTERS]

[5.3](#) Private use and replacement characters

Because private-use characters do not have defined meanings, they are prohibited. The private-use characters are:

E000-F8FF; [PRIVATE USE, PLANE 0]
F0000-FFFFD; [PRIVATE USE, PLANE 15]
100000-10FFFFD; [PRIVATE USE, PLANE 16]

The replacement character (U+FFFD) has no known semantic definition in a name, and is often displayed by renderers to indicate "there would be some character here, but it cannot be rendered". For example, on a computer with no Asian fonts, a name with three ideographs might be rendered with three replacement characters.

FFFD; REPLACEMENT CHARACTER

[5.4](#) Non-character code points

Non-character code points are code points that have been allocated in ISO/IEC 10646 but are not characters. Because they are already assigned, they are guaranteed not to later change into characters.

FDD0-FDEF; [NONCHARACTER CODE POINTS]
FFFE-FFFF; [NONCHARACTER CODE POINTS]
1FFFE-1FFFF; [NONCHARACTER CODE POINTS]
2FFFE-2FFFF; [NONCHARACTER CODE POINTS]
3FFFE-3FFFF; [NONCHARACTER CODE POINTS]
4FFFE-4FFFF; [NONCHARACTER CODE POINTS]
5FFFE-5FFFF; [NONCHARACTER CODE POINTS]
6FFFE-6FFFF; [NONCHARACTER CODE POINTS]
7FFFE-7FFFF; [NONCHARACTER CODE POINTS]
8FFFE-8FFFF; [NONCHARACTER CODE POINTS]
9FFFE-9FFFF; [NONCHARACTER CODE POINTS]
AFFFE-AFFFF; [NONCHARACTER CODE POINTS]
BFFFE-BFFFF; [NONCHARACTER CODE POINTS]
CFFFE-CFFFF; [NONCHARACTER CODE POINTS]
DFFFE-DFFFF; [NONCHARACTER CODE POINTS]
EFFFE-EFFFF; [NONCHARACTER CODE POINTS]
FFFFE-FFFFF; [NONCHARACTER CODE POINTS]
10FFFE-10FFFF; [NONCHARACTER CODE POINTS]

The non-character code points are listed the PropList.txt file from the Unicode database.

[5.5](#) Surrogate codes

The following code points are permanently reserved for use as surrogate code values in the UTF-16 encoding, will never be assigned to characters, and are therefore prohibited:

D800–DFFF; [SURROGATE CODES]

[5.6](#) Inappropriate for plain text

The following characters should not appear in regular text.

FFF9; INTERLINEAR ANNOTATION ANCHOR
FFFA; INTERLINEAR ANNOTATION SEPARATOR
FFFB; INTERLINEAR ANNOTATION TERMINATOR
FFFC; OBJECT REPLACEMENT CHARACTER

[5.7](#) Inappropriate for canonical representation

The ideographic description characters allow different sequences of characters to be rendered the same way, which makes them inappropriate for host names that must have a single canonical representation.

2FF0–2FFB; [IDEOGRAPHIC DESCRIPTION CHARACTERS]

[5.8](#) Change display properties

The following characters, some of which are deprecated in ISO/IEC 10646, can cause changes in display or the order in which characters appear when rendered.

200E; LEFT-TO-RIGHT MARK
200F; RIGHT-TO-LEFT MARK
202A; LEFT-TO-RIGHT EMBEDDING
202B; RIGHT-TO-LEFT EMBEDDING
202C; POP DIRECTIONAL FORMATTING
202D; LEFT-TO-RIGHT OVERRIDE
202E; RIGHT-TO-LEFT OVERRIDE
206A; INHIBIT SYMMETRIC SWAPPING
206B; ACTIVATE SYMMETRIC SWAPPING
206C; INHIBIT ARABIC FORM SHAPING
206D; ACTIVATE ARABIC FORM SHAPING
206E; NATIONAL DIGIT SHAPES
206F; NOMINAL DIGIT SHAPES

[5.9](#) Inappropriate characters from common input mechanisms

U+3002 is used as if it were U+002E in many input mechanisms, particularly in Asia. This prohibition allows input mechanisms to safely map U+3002 to U+002E before doing stringprep without worrying about preventing users from accessing legitimate host name parts.

3002; IDEOGRAPHIC FULL STOP

[5.10](#) Tagging characters

The following characters are used for tagging text and are invisible.

E0001; LANGUAGE TAG
E0020-E007F; [TAGGING CHARACTERS]

[6](#). Unassigned Code Points in Internationalized Host Names

This profile lists the unassigned code points for Unicode 3.1 in [Appendix F](#). The list in [Appendix F](#) MUST be used by implementations of this specification. If there are any discrepancies between the list in Appendix F and the Unicode 3.1 specification, the list [Appendix F](#) always takes precedence.

[7](#). Security Considerations

ISO/IEC 10646 has many characters that look similar. In many cases, users of security protocols might do visual matching, such as when comparing the names of trusted third parties. This profile does nothing to map similar-looking characters together.

Much of the security of the Internet relies on the DNS. Thus, any change to the characteristics of the DNS can change the security of much of the Internet.

Host names are used by users to connect to Internet servers. The security of the Internet would be compromised if a user entering a single internationalized name could be connected to different servers based on different interpretations of the internationalized host name.

Current applications may assume that the characters allowed in host names will always be the same as they are in [[STD13](#)]. This document vastly increases the number of characters available in host names. Every program that uses "special" characters in conjunction with host names may be vulnerable to attack based on the new characters allowed by this specification.

[8](#). References

[CharModel] Unicode Technical Report;17, Character Encoding Model.
<<http://www.unicode.org/unicode/reports/tr17/>>.

[Glossary] Unicode Glossary, <<http://www.unicode.org/glossary/>>.

[ISO10646] ISO/IEC 10646-1:2000. International Standard -- Information technology -- Universal Multiple-Octet Coded Character Set (UCS) -- Part 1: Architecture and Basic Multilingual Plane.

[RFC2119] Scott Bradner, "Key words for use in RFCs to Indicate Requirement Levels", March 1997, [RFC 2119](#).

[STD13] Paul Mockapetris, "Domain names - concepts and facilities" (RFC 1034) and "Domain names - implementation and specification" ([RFC 1035](#), STD 13, November 1987.

[STRINGPREP] Paul Hoffman and Marc Blanchet, "Preparation of Internationalized Strings ("stringprep")", [draft-hoffman-stringprep](#), work in progress

[Unicode3.1] The Unicode Standard, Version 3.1.0: The Unicode Consortium. The Unicode Standard, Version 3.0. Reading, MA, Addison-Wesley Developers Press, 2000. ISBN 0-201-61633-5, as amended by: Unicode Standard Annex #27: Unicode 3.1
<<http://www.unicode.org/unicode/reports/tr27/tr27-4.html>>.

[URI] For example: Roy Fielding et al., "Uniform Resource Identifiers: Generic Syntax", August 1998, [RFC 2396](#); Robert Hinden et. al, "IPv6 Literal Addresses in URL's", December 1999, [RFC 2732](#). Note that there are many other RFCs that define additional URI schemes.

[UAX15] Mark Davis and Martin Duerst. Unicode Standard Annex #15: Unicode Normalization Forms, Version 3.1.0.
<<http://www.unicode.org/unicode/reports/tr15/tr15-21.html>>

[UTR21] Mark Davis. Case Mappings. Unicode Technical Report;21.
<<http://www.unicode.org/unicode/reports/tr21/>>.

9. Differences Between -06 and -07 Drafts

5: Removed 5.1 (currently-used ASCII characters) and renumbered the entire section.

E: Removed the characters that appeared in the old 5.1.

A. Acknowledgements

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Mark Davis
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Patrik Faltstrom
Paul Hoffman

Additional significant improvements were proposed by:

Jonathan Rosenne
Kent Karlsson
Scott Hollenbeck
Dave Crocker

B. IANA Considerations

This is a profile of stringprep. When it becomes an RFC, it should be registered in the stringprep profile registry.

C. Author Contact Information

Paul Hoffman
Internet Mail Consortium and VPN Consortium
[127](#) Segre Place
Santa Cruz, CA 95060 USA
paul.hoffman@imc.org and paul.hoffman@vpnc.org

Marc Blanchet
Viagenie inc.
[2875](#) boul. Laurier, bur. 300
Ste-Foy, Quebec, Canada, G1V 2M2
Marc.Blanchet@viagenie.qc.ca

D. Mapping Tables

The following is the mapping table from [Section 3](#). The table has three columns:

- the character that is mapped from
- the zero or more characters that it is mapped to
- the reason for the mapping

The columns are separated by semicolons. Note that the second column may be empty, or it may have one character, or it may have more than one character, with each character separated by a space.

----- Start Mapping Table -----

0041; 0061; Case map
0042; 0062; Case map
0043; 0063; Case map
0044; 0064; Case map
0045; 0065; Case map
0046; 0066; Case map
0047; 0067; Case map
0048; 0068; Case map
0049; 0069; Case map
004A; 006A; Case map
004B; 006B; Case map
004C; 006C; Case map
004D; 006D; Case map
004E; 006E; Case map
004F; 006F; Case map
0050; 0070; Case map
0051; 0071; Case map
0052; 0072; Case map
0053; 0073; Case map
0054; 0074; Case map
0055; 0075; Case map
0056; 0076; Case map
0057; 0077; Case map
0058; 0078; Case map
0059; 0079; Case map
005A; 007A; Case map
00AD; ; Map out
00B5; 03BC; Case map
00C0; 00E0; Case map
00C1; 00E1; Case map
00C2; 00E2; Case map
00C3; 00E3; Case map
00C4; 00E4; Case map
00C5; 00E5; Case map
00C6; 00E6; Case map
00C7; 00E7; Case map
00C8; 00E8; Case map
00C9; 00E9; Case map
00CA; 00EA; Case map
00CB; 00EB; Case map
00CC; 00EC; Case map
00CD; 00ED; Case map
00CE; 00EE; Case map
00CF; 00EF; Case map
00D0; 00F0; Case map
00D1; 00F1; Case map
00D2; 00F2; Case map
00D3; 00F3; Case map
00D4; 00F4; Case map
00D5; 00F5; Case map
00D6; 00F6; Case map

00D8; 00F8; Case map
00D9; 00F9; Case map
00DA; 00FA; Case map
00DB; 00FB; Case map
00DC; 00FC; Case map
00DD; 00FD; Case map
00DE; 00FE; Case map
00DF; 0073 0073; Case map
0100; 0101; Case map
0102; 0103; Case map
0104; 0105; Case map
0106; 0107; Case map
0108; 0109; Case map
010A; 010B; Case map
010C; 010D; Case map
010E; 010F; Case map
0110; 0111; Case map
0112; 0113; Case map
0114; 0115; Case map
0116; 0117; Case map
0118; 0119; Case map
011A; 011B; Case map
011C; 011D; Case map
011E; 011F; Case map
0120; 0121; Case map
0122; 0123; Case map
0124; 0125; Case map
0126; 0127; Case map
0128; 0129; Case map
012A; 012B; Case map
012C; 012D; Case map
012E; 012F; Case map
0130; 0069; Case map
0131; 0069; Case map
0132; 0133; Case map
0134; 0135; Case map
0136; 0137; Case map
0139; 013A; Case map
013B; 013C; Case map
013D; 013E; Case map
013F; 0140; Case map
0141; 0142; Case map
0143; 0144; Case map
0145; 0146; Case map
0147; 0148; Case map
0149; 02BC 006E; Case map
014A; 014B; Case map
014C; 014D; Case map
014E; 014F; Case map
0150; 0151; Case map
0152; 0153; Case map

0154; 0155; Case map
0156; 0157; Case map
0158; 0159; Case map
015A; 015B; Case map
015C; 015D; Case map
015E; 015F; Case map
0160; 0161; Case map
0162; 0163; Case map
0164; 0165; Case map
0166; 0167; Case map
0168; 0169; Case map
016A; 016B; Case map
016C; 016D; Case map
016E; 016F; Case map
0170; 0171; Case map
0172; 0173; Case map
0174; 0175; Case map
0176; 0177; Case map
0178; 00FF; Case map
0179; 017A; Case map
017B; 017C; Case map
017D; 017E; Case map
017F; 0073; Case map
0181; 0253; Case map
0182; 0183; Case map
0184; 0185; Case map
0186; 0254; Case map
0187; 0188; Case map
0189; 0256; Case map
018A; 0257; Case map
018B; 018C; Case map
018E; 01DD; Case map
018F; 0259; Case map
0190; 025B; Case map
0191; 0192; Case map
0193; 0260; Case map
0194; 0263; Case map
0196; 0269; Case map
0197; 0268; Case map
0198; 0199; Case map
019C; 026F; Case map
019D; 0272; Case map
019F; 0275; Case map
01A0; 01A1; Case map
01A2; 01A3; Case map
01A4; 01A5; Case map
01A6; 0280; Case map
01A7; 01A8; Case map
01A9; 0283; Case map
01AC; 01AD; Case map
01AE; 0288; Case map

01AF; 01B0; Case map
01B1; 028A; Case map
01B2; 028B; Case map
01B3; 01B4; Case map
01B5; 01B6; Case map
01B7; 0292; Case map
01B8; 01B9; Case map
01BC; 01BD; Case map
01C4; 01C6; Case map
01C5; 01C6; Case map
01C7; 01C9; Case map
01C8; 01C9; Case map
01CA; 01CC; Case map
01CB; 01CC; Case map
01CD; 01CE; Case map
01CF; 01D0; Case map
01D1; 01D2; Case map
01D3; 01D4; Case map
01D5; 01D6; Case map
01D7; 01D8; Case map
01D9; 01DA; Case map
01DB; 01DC; Case map
01DE; 01DF; Case map
01E0; 01E1; Case map
01E2; 01E3; Case map
01E4; 01E5; Case map
01E6; 01E7; Case map
01E8; 01E9; Case map
01EA; 01EB; Case map
01EC; 01ED; Case map
01EE; 01EF; Case map
01F0; 006A 030C; Case map
01F1; 01F3; Case map
01F2; 01F3; Case map
01F4; 01F5; Case map
01F6; 0195; Case map
01F7; 01BF; Case map
01F8; 01F9; Case map
01FA; 01FB; Case map
01FC; 01FD; Case map
01FE; 01FF; Case map
0200; 0201; Case map
0202; 0203; Case map
0204; 0205; Case map
0206; 0207; Case map
0208; 0209; Case map
020A; 020B; Case map
020C; 020D; Case map
020E; 020F; Case map
0210; 0211; Case map
0212; 0213; Case map

0214; 0215; Case map
0216; 0217; Case map
0218; 0219; Case map
021A; 021B; Case map
021C; 021D; Case map
021E; 021F; Case map
0222; 0223; Case map
0224; 0225; Case map
0226; 0227; Case map
0228; 0229; Case map
022A; 022B; Case map
022C; 022D; Case map
022E; 022F; Case map
0230; 0231; Case map
0232; 0233; Case map
0345; 03B9; Case map
037A; 0020 03B9; Additional folding
0386; 03AC; Case map
0388; 03AD; Case map
0389; 03AE; Case map
038A; 03AF; Case map
038C; 03CC; Case map
038E; 03CD; Case map
038F; 03CE; Case map
0390; 03B9 0308 0301; Case map
0391; 03B1; Case map
0392; 03B2; Case map
0393; 03B3; Case map
0394; 03B4; Case map
0395; 03B5; Case map
0396; 03B6; Case map
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039A; 03BA; Case map
039B; 03BB; Case map
039C; 03BC; Case map
039D; 03BD; Case map
039E; 03BE; Case map
039F; 03BF; Case map
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03A1; 03C1; Case map
03A3; 03C3; Case map
03A4; 03C4; Case map
03A5; 03C5; Case map
03A6; 03C6; Case map
03A7; 03C7; Case map
03A8; 03C8; Case map
03A9; 03C9; Case map
03AA; 03CA; Case map
03AB; 03CB; Case map

03B0; 03C5 0308 0301; Case map
03C2; 03C3; Case map
03D0; 03B2; Case map
03D1; 03B8; Case map
03D2; 03C5; Additional folding
03D3; 03CD; Additional folding
03D4; 03CB; Additional folding
03D5; 03C6; Case map
03D6; 03C0; Case map
03DA; 03DB; Case map
03DC; 03DD; Case map
03DE; 03DF; Case map
03E0; 03E1; Case map
03E2; 03E3; Case map
03E4; 03E5; Case map
03E6; 03E7; Case map
03E8; 03E9; Case map
03EA; 03EB; Case map
03EC; 03ED; Case map
03EE; 03EF; Case map
03F0; 03BA; Case map
03F1; 03C1; Case map
03F2; 03C3; Case map
03F4; 03B8; Case map
03F5; 03B5; Case map
0400; 0450; Case map
0401; 0451; Case map
0402; 0452; Case map
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0404; 0454; Case map
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0408; 0458; Case map
0409; 0459; Case map
040A; 045A; Case map
040B; 045B; Case map
040C; 045C; Case map
040D; 045D; Case map
040E; 045E; Case map
040F; 045F; Case map
0410; 0430; Case map
0411; 0431; Case map
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0413; 0433; Case map
0414; 0434; Case map
0415; 0435; Case map
0416; 0436; Case map
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0418; 0438; Case map
0419; 0439; Case map

041A; 043A; Case map
041B; 043B; Case map
041C; 043C; Case map
041D; 043D; Case map
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0462; 0463; Case map
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0468; 0469; Case map
046A; 046B; Case map
046C; 046D; Case map
046E; 046F; Case map
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0472; 0473; Case map
0474; 0475; Case map
0476; 0477; Case map
0478; 0479; Case map
047A; 047B; Case map
047C; 047D; Case map
047E; 047F; Case map
0480; 0481; Case map
048C; 048D; Case map
048E; 048F; Case map
0490; 0491; Case map
0492; 0493; Case map
0494; 0495; Case map
0496; 0497; Case map
0498; 0499; Case map
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1D4DA; 006B; Additional folding
1D4DB; 006C; Additional folding
1D4DC; 006D; Additional folding
1D4DD; 006E; Additional folding
1D4DE; 006F; Additional folding
1D4DF; 0070; Additional folding
1D4E0; 0071; Additional folding
1D4E1; 0072; Additional folding
1D4E2; 0073; Additional folding
1D4E3; 0074; Additional folding
1D4E4; 0075; Additional folding
1D4E5; 0076; Additional folding
1D4E6; 0077; Additional folding
1D4E7; 0078; Additional folding
1D4E8; 0079; Additional folding
1D4E9; 007A; Additional folding
1D504; 0061; Additional folding
1D505; 0062; Additional folding
1D507; 0064; Additional folding
1D508; 0065; Additional folding
1D509; 0066; Additional folding
1D50A; 0067; Additional folding
1D50D; 006A; Additional folding
1D50E; 006B; Additional folding
1D50F; 006C; Additional folding
1D510; 006D; Additional folding
1D511; 006E; Additional folding
1D512; 006F; Additional folding
1D513; 0070; Additional folding
1D514; 0071; Additional folding
1D516; 0073; Additional folding
1D517; 0074; Additional folding
1D518; 0075; Additional folding
1D519; 0076; Additional folding
1D51A; 0077; Additional folding
1D51B; 0078; Additional folding
1D51C; 0079; Additional folding
1D538; 0061; Additional folding
1D539; 0062; Additional folding
1D53B; 0064; Additional folding
1D53C; 0065; Additional folding
1D53D; 0066; Additional folding
1D53E; 0067; Additional folding
1D540; 0069; Additional folding
1D541; 006A; Additional folding
1D542; 006B; Additional folding
1D543; 006C; Additional folding
1D544; 006D; Additional folding
1D546; 006F; Additional folding

1D54A; 0073; Additional folding
1D54B; 0074; Additional folding
1D54C; 0075; Additional folding
1D54D; 0076; Additional folding
1D54E; 0077; Additional folding
1D54F; 0078; Additional folding
1D550; 0079; Additional folding
1D56C; 0061; Additional folding
1D56D; 0062; Additional folding
1D56E; 0063; Additional folding
1D56F; 0064; Additional folding
1D570; 0065; Additional folding
1D571; 0066; Additional folding
1D572; 0067; Additional folding
1D573; 0068; Additional folding
1D574; 0069; Additional folding
1D575; 006A; Additional folding
1D576; 006B; Additional folding
1D577; 006C; Additional folding
1D578; 006D; Additional folding
1D579; 006E; Additional folding
1D57A; 006F; Additional folding
1D57B; 0070; Additional folding
1D57C; 0071; Additional folding
1D57D; 0072; Additional folding
1D57E; 0073; Additional folding
1D57F; 0074; Additional folding
1D580; 0075; Additional folding
1D581; 0076; Additional folding
1D582; 0077; Additional folding
1D583; 0078; Additional folding
1D584; 0079; Additional folding
1D585; 007A; Additional folding
1D5A0; 0061; Additional folding
1D5A1; 0062; Additional folding
1D5A2; 0063; Additional folding
1D5A3; 0064; Additional folding
1D5A4; 0065; Additional folding
1D5A5; 0066; Additional folding
1D5A6; 0067; Additional folding
1D5A7; 0068; Additional folding
1D5A8; 0069; Additional folding
1D5A9; 006A; Additional folding
1D5AA; 006B; Additional folding
1D5AB; 006C; Additional folding
1D5AC; 006D; Additional folding
1D5AD; 006E; Additional folding
1D5AE; 006F; Additional folding
1D5AF; 0070; Additional folding
1D5B0; 0071; Additional folding
1D5B1; 0072; Additional folding

1D5B2; 0073; Additional folding
1D5B3; 0074; Additional folding
1D5B4; 0075; Additional folding
1D5B5; 0076; Additional folding
1D5B6; 0077; Additional folding
1D5B7; 0078; Additional folding
1D5B8; 0079; Additional folding
1D5B9; 007A; Additional folding
1D5D4; 0061; Additional folding
1D5D5; 0062; Additional folding
1D5D6; 0063; Additional folding
1D5D7; 0064; Additional folding
1D5D8; 0065; Additional folding
1D5D9; 0066; Additional folding
1D5DA; 0067; Additional folding
1D5DB; 0068; Additional folding
1D5DC; 0069; Additional folding
1D5DD; 006A; Additional folding
1D5DE; 006B; Additional folding
1D5DF; 006C; Additional folding
1D5E0; 006D; Additional folding
1D5E1; 006E; Additional folding
1D5E2; 006F; Additional folding
1D5E3; 0070; Additional folding
1D5E4; 0071; Additional folding
1D5E5; 0072; Additional folding
1D5E6; 0073; Additional folding
1D5E7; 0074; Additional folding
1D5E8; 0075; Additional folding
1D5E9; 0076; Additional folding
1D5EA; 0077; Additional folding
1D5EB; 0078; Additional folding
1D5EC; 0079; Additional folding
1D5ED; 007A; Additional folding
1D608; 0061; Additional folding
1D609; 0062; Additional folding
1D60A; 0063; Additional folding
1D60B; 0064; Additional folding
1D60C; 0065; Additional folding
1D60D; 0066; Additional folding
1D60E; 0067; Additional folding
1D60F; 0068; Additional folding
1D610; 0069; Additional folding
1D611; 006A; Additional folding
1D612; 006B; Additional folding
1D613; 006C; Additional folding
1D614; 006D; Additional folding
1D615; 006E; Additional folding
1D616; 006F; Additional folding
1D617; 0070; Additional folding
1D618; 0071; Additional folding

1D619; 0072; Additional folding
1D61A; 0073; Additional folding
1D61B; 0074; Additional folding
1D61C; 0075; Additional folding
1D61D; 0076; Additional folding
1D61E; 0077; Additional folding
1D61F; 0078; Additional folding
1D620; 0079; Additional folding
1D621; 007A; Additional folding
1D63C; 0061; Additional folding
1D63D; 0062; Additional folding
1D63E; 0063; Additional folding
1D63F; 0064; Additional folding
1D640; 0065; Additional folding
1D641; 0066; Additional folding
1D642; 0067; Additional folding
1D643; 0068; Additional folding
1D644; 0069; Additional folding
1D645; 006A; Additional folding
1D646; 006B; Additional folding
1D647; 006C; Additional folding
1D648; 006D; Additional folding
1D649; 006E; Additional folding
1D64A; 006F; Additional folding
1D64B; 0070; Additional folding
1D64C; 0071; Additional folding
1D64D; 0072; Additional folding
1D64E; 0073; Additional folding
1D64F; 0074; Additional folding
1D650; 0075; Additional folding
1D651; 0076; Additional folding
1D652; 0077; Additional folding
1D653; 0078; Additional folding
1D654; 0079; Additional folding
1D655; 007A; Additional folding
1D670; 0061; Additional folding
1D671; 0062; Additional folding
1D672; 0063; Additional folding
1D673; 0064; Additional folding
1D674; 0065; Additional folding
1D675; 0066; Additional folding
1D676; 0067; Additional folding
1D677; 0068; Additional folding
1D678; 0069; Additional folding
1D679; 006A; Additional folding
1D67A; 006B; Additional folding
1D67B; 006C; Additional folding
1D67C; 006D; Additional folding
1D67D; 006E; Additional folding
1D67E; 006F; Additional folding
1D67F; 0070; Additional folding

1D680; 0071; Additional folding
1D681; 0072; Additional folding
1D682; 0073; Additional folding
1D683; 0074; Additional folding
1D684; 0075; Additional folding
1D685; 0076; Additional folding
1D686; 0077; Additional folding
1D687; 0078; Additional folding
1D688; 0079; Additional folding
1D689; 007A; Additional folding
1D6A8; 03B1; Additional folding
1D6A9; 03B2; Additional folding
1D6AA; 03B3; Additional folding
1D6AB; 03B4; Additional folding
1D6AC; 03B5; Additional folding
1D6AD; 03B6; Additional folding
1D6AE; 03B7; Additional folding
1D6AF; 03B8; Additional folding
1D6B0; 03B9; Additional folding
1D6B1; 03BA; Additional folding
1D6B2; 03BB; Additional folding
1D6B3; 03BC; Additional folding
1D6B4; 03BD; Additional folding
1D6B5; 03BE; Additional folding
1D6B6; 03BF; Additional folding
1D6B7; 03C0; Additional folding
1D6B8; 03C1; Additional folding
1D6B9; 03B8; Additional folding
1D6BA; 03C3; Additional folding
1D6BB; 03C4; Additional folding
1D6BC; 03C5; Additional folding
1D6BD; 03C6; Additional folding
1D6BE; 03C7; Additional folding
1D6BF; 03C8; Additional folding
1D6C0; 03C9; Additional folding
1D6D3; 03C3; Additional folding
1D6E2; 03B1; Additional folding
1D6E3; 03B2; Additional folding
1D6E4; 03B3; Additional folding
1D6E5; 03B4; Additional folding
1D6E6; 03B5; Additional folding
1D6E7; 03B6; Additional folding
1D6E8; 03B7; Additional folding
1D6E9; 03B8; Additional folding
1D6EA; 03B9; Additional folding
1D6EB; 03BA; Additional folding
1D6EC; 03BB; Additional folding
1D6ED; 03BC; Additional folding
1D6EE; 03BD; Additional folding
1D6EF; 03BE; Additional folding
1D6F0; 03BF; Additional folding

1D6F1; 03C0; Additional folding
1D6F2; 03C1; Additional folding
1D6F3; 03B8; Additional folding
1D6F4; 03C3; Additional folding
1D6F5; 03C4; Additional folding
1D6F6; 03C5; Additional folding
1D6F7; 03C6; Additional folding
1D6F8; 03C7; Additional folding
1D6F9; 03C8; Additional folding
1D6FA; 03C9; Additional folding
1D70D; 03C3; Additional folding
1D71C; 03B1; Additional folding
1D71D; 03B2; Additional folding
1D71E; 03B3; Additional folding
1D71F; 03B4; Additional folding
1D720; 03B5; Additional folding
1D721; 03B6; Additional folding
1D722; 03B7; Additional folding
1D723; 03B8; Additional folding
1D724; 03B9; Additional folding
1D725; 03BA; Additional folding
1D726; 03BB; Additional folding
1D727; 03BC; Additional folding
1D728; 03BD; Additional folding
1D729; 03BE; Additional folding
1D72A; 03BF; Additional folding
1D72B; 03C0; Additional folding
1D72C; 03C1; Additional folding
1D72D; 03B8; Additional folding
1D72E; 03C3; Additional folding
1D72F; 03C4; Additional folding
1D730; 03C5; Additional folding
1D731; 03C6; Additional folding
1D732; 03C7; Additional folding
1D733; 03C8; Additional folding
1D734; 03C9; Additional folding
1D747; 03C3; Additional folding
1D756; 03B1; Additional folding
1D757; 03B2; Additional folding
1D758; 03B3; Additional folding
1D759; 03B4; Additional folding
1D75A; 03B5; Additional folding
1D75B; 03B6; Additional folding
1D75C; 03B7; Additional folding
1D75D; 03B8; Additional folding
1D75E; 03B9; Additional folding
1D75F; 03BA; Additional folding
1D760; 03BB; Additional folding
1D761; 03BC; Additional folding
1D762; 03BD; Additional folding
1D763; 03BE; Additional folding

1D764; 03BF; Additional folding
1D765; 03C0; Additional folding
1D766; 03C1; Additional folding
1D767; 03B8; Additional folding
1D768; 03C3; Additional folding
1D769; 03C4; Additional folding
1D76A; 03C5; Additional folding
1D76B; 03C6; Additional folding
1D76C; 03C7; Additional folding
1D76D; 03C8; Additional folding
1D76E; 03C9; Additional folding
1D781; 03C3; Additional folding
1D790; 03B1; Additional folding
1D791; 03B2; Additional folding
1D792; 03B3; Additional folding
1D793; 03B4; Additional folding
1D794; 03B5; Additional folding
1D795; 03B6; Additional folding
1D796; 03B7; Additional folding
1D797; 03B8; Additional folding
1D798; 03B9; Additional folding
1D799; 03BA; Additional folding
1D79A; 03BB; Additional folding
1D79B; 03BC; Additional folding
1D79C; 03BD; Additional folding
1D79D; 03BE; Additional folding
1D79E; 03BF; Additional folding
1D79F; 03C0; Additional folding
1D7A0; 03C1; Additional folding
1D7A1; 03B8; Additional folding
1D7A2; 03C3; Additional folding
1D7A3; 03C4; Additional folding
1D7A4; 03C5; Additional folding
1D7A5; 03C6; Additional folding
1D7A6; 03C7; Additional folding
1D7A7; 03C8; Additional folding
1D7A8; 03C9; Additional folding
1D7BB; 03C3; Additional folding
----- End Mapping Table -----

E. Prohibited Code Point List

----- Start Prohibited Table -----
0000-0020
007F
0080-009F
00A0
070F
1680
180E

2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
200A
200E
200F
2028
2029
202A
202B
202C
202D
202E
202F
206A-206F
2FF0-2FFB
3000
3002
D800-DFFF
E000-F8FF
FDD0-FDEF
FFF9-FFFC
FFFD
FFFE-FFFF
1D173-1D17A
1FFFE-1FFFF
2FFFE-2FFFF
3FFFE-3FFFF
4FFFE-4FFFF
5FFFE-5FFFF
6FFFE-6FFFF
7FFFE-7FFFF
8FFFE-8FFFF
9FFFE-9FFFF
AFFFE-AFFFF
BFFFE-BFFFF
CFFFE-CFFFF
DFFFE-DFFFF
E0001
E0020-E007F
EFFFF-EFFFF
F0000-FFFFD
FFFFE-FFFFF
100000-10FFFD

10FFFE-10FFFF

----- End Prohibited Table -----

NOTE WELL: Software that follows this specification that will be used to check names before they are put in authoritative name servers MUST add all unassigned code pints to the list of characters that are prohibited. See Section 6 of [[STRINGPREP](#)] for more details.

E. Unassigned Code Point List

----- Start Unassigned Table -----

0220-0221

0234-024F

02AE-02AF

02EF-02FF

034F-035F

0363-0373

0376-0379

037B-037D

037F-0383

038B

038D

03A2

03CF

03D8-03D9

03F6-03FF

0487

048A-048B

04C5-04C6

04C9-04CA

04CD-04CF

04F6-04F7

04FA-0530

0557-0558

0560

0588

058B-0590

05A2

05BA

05C5-05CF

05EB-05EF

05F5-060B

060D-061A

061C-061E

0620

063B-063F

0656-065F

066E-066F

06EE-06EF

06FF

070E
072D-072F
074B-077F
07B1-0900
0904
093A-093B
094E-094F
0955-0957
0971-0980
0984
098D-098E
0991-0992
09A9
09B1
09B3-09B5
09BA-09BB
09BD
09C5-09C6
09C9-09CA
09CE-09D6
09D8-09DB
09DE
09E4-09E5
09FB-0A01
0A03-0A04
0A0B-0A0E
0A11-0A12
0A29
0A31
0A34
0A37
0A3A-0A3B
0A3D
0A43-0A46
0A49-0A4A
0A4E-0A58
0A5D
0A5F-0A65
0A75-0A80
0A84
0A8C
0A8E
0A92
0AA9
0AB1
0AB4
0ABA-0ABB
0AC6
0ACA
0ACE-0ACF
0AD1-0ADF

0AE1-0AE5
0AF0-0B00
0B04
0B0D-0B0E
0B11-0B12
0B29
0B31
0B34-0B35
0B3A-0B3B
0B44-0B46
0B49-0B4A
0B4E-0B55
0B58-0B5B
0B5E
0B62-0B65
0B71-0B81
0B84
0B8B-0B8D
0B91
0B96-0B98
0B9B
0B9D
0BA0-0BA2
0BA5-0BA7
0BAB-0BAD
0BB6
0BBA-0BBD
0BC3-0BC5
0BC9
0BCE-0BD6
0BD8-0BE6
0BF3-0C00
0C04
0C0D
0C11
0C29
0C34
0C3A-0C3D
0C45
0C49
0C4E-0C54
0C57-0C5F
0C62-0C65
0C70-0C81
0C84
0C8D
0C91
0CA9
0CB4
0CBA-0CBD
0CC5

0CC9
0CCE-0CD4
0CD7-0CDD
0CDF
0CE2-0CE5
0CF0-0D01
0D04
0D0D
0D11
0D29
0D3A-0D3D
0D44-0D45
0D49
0D4E-0D56
0D58-0D5F
0D62-0D65
0D70-0D81
0D84
0D97-0D99
0DB2
0DBC
0DBE-0DBF
0DC7-0DC9
0DCB-0DCE
0DD5
0DD7
0DE0-0DF1
0DF5-0E00
0E3B-0E3E
0E5C-0E80
0E83
0E85-0E86
0E89
0E8B-0E8C
0E8E-0E93
0E98
0EA0
0EA4
0EA6
0EA8-0EA9
0EAC
0EBA
0EBE-0EBF
0EC5
0EC7
0ECE-0ECF
0EDA-0EDB
0EDE-0EFF
0F48
0F6B-0F70
0F8C-0F8F

0F98
0FBD
0FCD-0FCE
0FD0-0FFF
1022
1028
102B
1033-1035
103A-103F
105A-109F
10C6-10CF
10F7-10FA
10FC-10FF
115A-115E
11A3-11A7
11FA-11FF
1207
1247
1249
124E-124F
1257
1259
125E-125F
1287
1289
128E-128F
12AF
12B1
12B6-12B7
12BF
12C1
12C6-12C7
12CF
12D7
12EF
130F
1311
1316-1317
131F
1347
135B-1360
137D-139F
13F5-1400
1677-167F
169D-169F
16F1-177F
17DD-17DF
17EA-17FF
180F
181A-181F
1878-187F

18AA-1DFF
1E9C-1E9F
1EFA-1EFF
1F16-1F17
1F1E-1F1F
1F46-1F47
1F4E-1F4F
1F58
1F5A
1F5C
1F5E
1F7E-1F7F
1FB5
1FC5
1FD4-1FD5
1FDC
1FF0-1FF1
1FF5
1FFF
2047
204E-2069
2071-2073
208F-209F
20B0-20CF
20E4-20FF
213B-2152
2184-218F
21F4-21FF
22F2-22FF
237C
239B-23FF
2427-243F
244B-245F
24EB-24FF
2596-259F
25F8-25FF
2614-2618
2672-2700
2705
270A-270B
2728
274C
274E
2753-2755
2757
275F-2760
2768-2775
2795-2797
27B0
27BF-27FF
2900-2E7F

2E9A
2EF4-2EFF
2FD6-2FEF
2FFC-2FFF
303B-303D
3040
3095-3098
309F-30A0
30FF-3104
312D-3130
318F
31B8-31FF
321D-321F
3244-325F
327C-327E
32B1-32BF
32CC-32CF
32FF
3377-337A
33DE-33DF
33FF
4DB6-4DFF
9FA6-9FFF
A48D-A48F
A4A2-A4A3
A4B4
A4C1
A4C5
A4C7-ABFF
D7A4-D7FF
FA2E-FAFF
FB07-FB12
FB18-FB1C
FB37
FB3D
FB3F
FB42
FB45
FBB2-FBD2
FD40-FD4F
FD90-FD91
FDC8-FDCF
FDFC-FE1F
FE24-FE2F
FE45-FE48
FE53
FE67
FE6C-FE6F
FE73
FE75
FEFD-FEFE

FF00
FF5F-FF60
FFBF-FFC1
FFC8-FFC9
FFD0-FFD1
FFD8-FFD9
FFDD-FFDF
FFE7
FFEF-FFF8
10000-102FF
1031F
10324-1032F
1034B-103FF
10426-10427
1044E-1CFFF
1D0F6-1D0FF
1D127-1D129
1D1DE-1D3FF
1D455
1D49D
1D4A0-1D4A1
1D4A3-1D4A4
1D4A7-1D4A8
1D4AD
1D4BA
1D4BC
1D4C1
1D4C4
1D506
1D50B-1D50C
1D515
1D51D
1D53A
1D53F
1D545
1D547-1D549
1D551
1D6A4-1D6A7
1D7CA-1D7CD
1D800-1FFFD
2A6D7-2F7FF
2FA1E-2FFFD
30000-3FFFD
40000-4FFFD
50000-5FFFD
60000-6FFFD
70000-7FFFD
80000-8FFFD
90000-9FFFD
A0000-AFFFD
B0000-BFFFD

C0000-CFFFD

D0000-DFFFD

E0000

E0002-E001F

E0080-EFFFD

----- End Unassigned Table -----