

## Core issue 789: Replacing Trigraphs

### Notes

In Summit, CWG agreed to deprecate trigraphs. In Frankfurt, IBM requested that an alternative solution be found that would not break their particular use of trigraphs in environments that assume EBCDIC encoding by default. This paper proposes wording to achieve that, while still addressing the spirit of comment UK 11 in N2800.

The gist of this proposal is to drop trigraphs altogether (instead of deprecating them) and replace their least uncommon uses by new tokens and new escape sequences (in non-raw strings). The "trigraph effect" is not emulated in raw strings and comments, nor are some perverse combinations like `??=#` (for `##`). I.e., this proposal attempts to address the major problem posed by trigraphs (that they counter-intuitively get substituted in raw strings), while enabling backward compatibility with any reasonable C++03 program in this respect. It would not be hard to add additional limitations on trigraph-like behavior: For example, trigraph-like substitution in strings could be disabled altogether, or it could be deprecated.

The changes are against N2914.

### Wording Changes

In 2.2 [lex.phases] paragraph 1 delete the sentence

[...] Trigraph sequences (2.4) are replaced by corresponding single-character internal representations. [...]

and replace

(i.e., using the `\uXXXX` notation)

by

(e.g., using the `\uXXXX` notation)

In 2.2 [lex.phases] paragraph 2 replace

... a backslash character (`\`) immediately followed ...

by

... a backslash character (`\`) or a character sequence `??/` immediately followed ...

In 2.3 [lex.charset] paragraph 1 add productions to the rule for *universal-character-name* as follows:

*universal-character-name*:

`\u hex-quad`

`??/u hex-quad`

`\U hex-quad hex-quad`

`??/U hex-quad hex-quad`

and in the text that follows replace

`\UNNNNNNNN`

by

`\UNNNNNNNN` or `??/UNNNNNNNN`

and

`\uNNNN`

by

`\uNNNNNNNN` or `??/uNNNN`

Delete subsection 2.4 [lex.trigraph].

In 2.6 [lex.digraph] replace footnote 14

14) These include “digraphs” and additional reserved words. The term “digraph” (token consisting of two characters) is not perfectly descriptive, since one of the alternative preprocessing-tokens is `%:` and of course several primary tokens contain two characters. Nonetheless, those alternative tokens that aren’t lexical keywords are colloquially known as “digraphs”.

by

14) The alternative tokens `<%`, `%>`, `<:`, `:>`, `%:`, and `%:%:` are colloquially known as “digraphs”. The alternative tokens containing a `??` character sequence are colloquially known as “trigraphs”; such character sequences were historically handled in translation phase 1 (2.2 `_lex.phases_`) but are now dealt with in later phases to allow for a more context-aware treatment.

and add entries to Table 2 as follows:

Alternative	Primary	Alternative	Primary	Alternative	Primary
<%	{	<b>and</b>	&&	<b>and_eq</b>	&=
%>	}	<b>bitor</b>		<b>or_eq</b>	=
<:	[	<b>or</b>		<b>xor_eq</b>	^=
:>	]	<b>xor</b>	^	<b>not</b>	!
%:	#	<b>compl</b>	~	<b>not_eq</b>	!=
%:%:	##	<b>bitand</b>	&	??'	^
??<	{	??!		??'='	^=
??>	}	??!??!		??!='	=
??(	[	??=	#	??-	~
??)	]	??=??=	##		

Replace 2.9 [lex.header] paragraph 2

- 2 If either of the characters ' or \, or **either** of the character sequences /\* or // appears in a *q-char-sequence* or a *h-char-sequence*, or the character " appears in a *h-char-sequence*, the behavior is undefined.<sup>17</sup>

by

- 2 If either of the characters ' or \, or **any** of the character sequences **??/**, /\* or // appears in a *q-char-sequence* or a *h-char-sequence*, or the character " appears in a *h-char-sequence*, the behavior is undefined.<sup>17</sup>

In 2.13 [lex.operators] paragraph 1 add the following preprocessing tokens to the production for *preprocessing-op-or-punc*:

??<	??>	??(	??)	??=	??=??=
??!	??!??!	??'	??'='	??!='	??-

In 2.14.3 [lex.ccon] add a production to the rule for *escape-sequence* as follows:

*escape-sequence*:

*simple-escape-sequence*  
*octal-escape-sequence*  
*hexadecimal-escape-sequence*  
*trigraph-escape-sequence*

*trigraph-escape-sequence*: one of

??=      ??'      ??(      ??)      ??!      ??<  
 ??>      ??-      ??/n      ??/t      ??/v      ??/b  
 ??/r      ??/f      ??/a      ??/??/      ??/?      ??/'  
 ??/"

and update the productions for *octal-escape-sequence* and *hexadecimal-escape-sequence* as follows:

*octal-escape-sequence*:

\ *octal-digit*  
 \ *octal-digit octal-digit*  
 \ *octal-digit octal-digit octal-digit*  
 ??/ *octal-digit*  
 ??/ *octal-digit octal-digit*  
 ??/ *octal-digit octal-digit octal-digit*

*hexadecimal-escape-sequence*:

\x *hexadecimal-digit*  
 ??/x *hexadecimal-digit*  
*hexadecimal-escape-sequence hexadecimal-digit*

In 2.14.3 [lex.ccon] replace paragraph 3

2 Certain nongraphic characters, the single quote ' , the double quote " , the question mark ?,<sup>22</sup> and the backslash \ , can be represented according to Table 6. The double quote " and the question mark ? , can be represented as themselves or by the escape sequences \" and \? respectively, but the single quote ' and the backslash \ shall be represented by the escape sequences \' and \\ respectively. Escape sequences in which the character following the backslash is not listed in Table 6 are conditionally-supported, with implementation-defined semantics. An escape sequence specifies a single character.

by

2 Escape sequences specify a single (graphic or nongraphic) character as specified in Table 6. [ *Note*: The single quote ' and the backslash \ characters must be represented using an escape sequence. Other characters from the basic source character set may be

written directly or through an escape sequence. —*end note* ] Escape sequences consisting of a `\` or `??/` followed by other characters but not listed in Table 6 are conditionally supported with implemented-defined semantics.

(thereby deleting footnote 22) and add entries to Table 6 as follows:

new-line	NL(LF)	<code>\n</code> or <code>??/n</code>
horizontal tab	HT	<code>\t</code> or <code>??/t</code>
vertical tab	VT	<code>\v</code> or <code>??/v</code>
backspace	BS	<code>\b</code> or <code>??/b</code>
carriage return	CR	<code>\r</code> or <code>??/r</code>
form feed	FF	<code>\f</code> or <code>??/f</code>
alert	BEL	<code>\a</code> or <code>??/a</code>
backslash	<code>\</code>	<code>\\</code> or <code>??/??/</code>
question mark	<code>?</code>	<code>\?</code> or <code>??/?</code>
single quote	<code>'</code>	<code>\'</code> or <code>??/'</code>
double quote	<code>"</code>	<code>\"</code> or <code>??/"</code>
octal number	<i>ooo</i>	<code>\ooo</code> or <code>??/ooo</code>
hex number	<i>hhh</i>	<code>\xooo</code> or <code>??/xhhh</code>
octothorp	<code>#</code>	<code>??=</code>
caret	<code>^</code>	<code>??'</code>
left bracket	<code>[</code>	<code>??(</code>
right bracket	<code>]</code>	<code>??)</code>
vertical line	<code> </code>	<code>??!</code>
left brace	<code>{</code>	<code>??&lt;</code>
right brace	<code>}</code>	<code>??&gt;</code>
tilde	<code>~</code>	<code>??-</code>

In 2.14.3 [lex.ccon] paragraph 4 replace the first two sentences

- 4 The escape `\ooo` consists of the backslash followed by one, two, or three octal digits that are taken to specify the value of the desired character. The escape `\xhhh` consists of the

backslash followed by **x** followed by one or more hexadecimal digits that are taken to specify the value of the desired character.

by

- 4 The octal digits in an *octal-escape-sequence* are taken to specify the value of the desired character. The hexadecimal digits in a *hexadecimal-escape-sequence* are taken to specify the value of the desired character.

In 2.14.5 [lex.string] paragraph 14. replace the first sentence

- 14 Escape sequences in non-raw string literals and universal-character-names in string literals have the same meaning as in character literals (2.14.3), except that the single quote ' is representable either by itself or by the escape sequence \', and the double quote " shall be preceded by a \.

by

- 14 Escape sequences in non-raw string literals and universal-character-names in string literals have the same meaning as in character literals (2.14.3). [ Note: The double quote " and the backslash \ characters must be represented using an escape sequence. Other characters from the basic source character set may be written directly or through an escape sequence. —end note ]