

First edition
2004-07-15

Information technology — Programming languages, their environments and system software interfaces — Extensions for the programming language C to support new character data types

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Technologies de l'information — Langages de programmation, leurs environnements et interfaces de logiciel système — Extensions pour que le langage de programmation C supporte des types de données de caractères nouveaux

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Reference number
ISO/IEC TR 19769:2004(E)



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Published in Switzerland

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of the joint technical committee is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

In exceptional circumstances, the joint technical committee may propose the publication of a Technical Report of one of the following types:

- type 1, when the required support cannot be obtained for the publication of an International Standard, despite repeated efforts;
- type 2, when the subject is still under technical development or where for any other reason there is the future but not immediate possibility of an agreement on an International Standard;
- type 3, when the joint technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example).

Technical Reports of types 1 and 2 are subject to review within three years of publication, to decide whether they can be transformed into International Standards. Technical Reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

ISO/IEC TR 19769, which is a Technical Report of type 2, was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 22, *Programming languages, their environments and system software interfaces*.

Introduction

The C language has evolved over the last decades, various code pages and multibyte libraries have been introduced, and extended character set support has been introduced; however, the support for extended character data types in the C language is still limited. Today, the introduction and the success of the Unicode/ISO10646 standard and of its implementation in modern computer languages create ever increasing demands on the C language to give Unicode/ISO10646 better support. This paper addresses the introduction of new extended character data types in the C language in order to support future character encoding forms, including Unicode/ISO10646.

The Unicode standard supports 3 encoding forms:

- UTF-8
- UTF-16
- UTF-32

Each encoding form has advantages and disadvantages, so the choice of the encoding form should be left to the application. Currently, some C applications implement UTF-8 using `char` type, UTF-16 using `unsigned short` or `wchar_t`, and UTF-32 using `unsigned long` or `wchar_t`. The current situation, however, faces the following major problems:

- The size of `wchar_t` is implementation defined. While `wchar_t` offers a form of platform portability for C applications, Unicode offers the possibility to write platform independent applications using a platform independent data format.
- There is no string literal for 16- or 32-bit based integer types, but the Unicode encoding forms require string literals.

It is sensible to give all the Unicode encoding forms appropriate data type support. UTF-8 is normally considered as the preferred multibyte encoding, for sequences of one or more elements of type `char`. This paper suggests the implementation of 16 and 32 bit character data types: `char16_t` and `char32_t`. The new data types guarantee program portability through clearly defined character widths. The encoding of the new data types should be as generic as possible in order to support not only Unicode but also other character encodings.

It is generally desirable that C applications process entire strings at once rather than process individual characters in isolation. This paper does not specify the detail of library functions for the new data types, except one set of character conversion functions.

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Information technology — Programming languages, their environments and system software interfaces — Extensions for the programming language C to support new character data types

1 Scope

This Technical Report specifies two extended character data types as an extension to the programming language C, specified by the international standard ISO/IEC 9899:1999.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 9899:1999, *Programming Language C*

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ISO/IEC 10646-1:2000, *Information technology — Universal multiple-octet coded character set (UCS) — Part 1: Architecture and Basic Multilingual Plane*

3 The new typedefs

This Technical Report introduces the following two new typedefs, `char16_t` and `char32_t`:

```
typedef      T1      char16_t;
typedef      T2      char32_t;
```

where *T1* has the same type as `uint_least16_t` and *T2* has the same type as `uint_least32_t`.

The new typedefs guarantee certain widths for the data types, whereas the width of `wchar_t` is implementation defined. The data values are unsigned, while `char` and `wchar_t` could take signed values.

This Technical Report also introduces the new header:

`<uchar.h>`

The new typedefs, `char16_t` and `char32_t`, are defined in `<uchar.h>`
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4 Encoding

C99 subclause 6.10.8 specifies that the value of the macro `__STDC_ISO_10646__` shall be "an integer constant of the form `yyymmL` (for example, `199712L`), intended to indicate that values of type `wchar_t` are the coded representations of the characters defined by ISO/IEC 10646, along with all amendments and technical corrigenda as of the specified year and month." C99 subclause 6.4.5p5 specifies that wide string literals are initialized with a sequence of wide characters as defined by the `mbstowcs` function with an implementation-defined current locale. Analogous to this macro, this Technical Report introduces two new macros.

If the header `<uchar.h>` defines the macro `__STDC_UTF_16__`, values of type `char16_t` shall have UTF-16 encoding. This allows the use of UTF-16 in `char16_t` even when `wchar_t` uses a non-Unicode encoding. In certain cases the compile-time conversion to UTF-16 may be restricted to members of the basic character set and universal character names (`\Uxxxxxxxx` and `\unxxx`) because for these the conversion to UTF-16 is defined unambiguously.

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If the header `<uchar.h>` defines the macro `__STDC_UTF_32__`, values of type `char32_t` shall have UTF-32 encoding.

If the header `<uchar.h>` does not define the macro `__STDC_UTF_16__`, the encoding of `char16_t` is implementation defined. Similarly, if the header `<uchar.h>` does not define the macro `__STDC_UTF_32__`, the encoding of `char32_t` is implementation defined.

An implementation may define other macros to indicate a different encoding.