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Subject: encode/decode functions to manage alternate encodings

This paper proposes adding to WG14/N1201 (TR 24732 draft of 2006/11/10) a specification of functionality for mapping between the encoding an implementation uses for its decimal types and a possibly different encoding used for external data. The functions proposed are required by 754R.

Background: 754R specifies semantics of decimal arithmetic in terms of values and representations (sign, coefficient, quantum exponent), not in terms of their bit-level encodings (called object representations in C99). 754R defines two encoding alternatives for decimal floating-point formats -- "decimal encoding" and "binary encoding" -- and allows (without recommending one over the other) an implementation to use either of these encodings for its decimal floating types. Note that "binary encoding" here refers to an encoding scheme for decimal formats, not for binary formats as the term might suggest.

As with endianness, programs (except those that interpret bits directly) need be concerned about the encoding only when reading or writing encoded external data. The bit-level encodings of decimal floating types, compared to those of binary floating types, are more difficult to interpret, and there's the extra complication of having two alternate encodings. Hence, programmers will not often access the bit-level encodings of the decimal types.

754R requires functions to convert between the encoding used by the implementation and each of the two 754R encoding alternatives. These functions enable a program to be independent of the implementation's encoding scheme, yet handle external data that has a known encoding. This document proposes enhancing the TR to specify the 754R functions, along with auxiliary "_t" types for handling data in each of the encodings.

Suggested TR changes:

In TR 9.4, pages 27-28, add the following suggested additions to C99:

7.12, after paragraph [2], insert:

These types, together with the functions in 7.12.15, facilitate handling external data in one of the two alternate encoding schemes 754R specifies for decimal floating types. The types

dec32_decencoding_t
dec64_decencoding_t
dec128_decencoding_t

are implementation-defined types that can store decimal floating-point data in the decimal encoding scheme specified in 754R. The types

dec32_binencoding_t
dec64_binencoding_t
dec128_binencoding_t

are implementation defined types that can store decimal floating-point data in the binary encoding scheme specified in 754R. These types are intended only for direct I/O and use with the decimal re-encoding functions in 7.12.15.

7.12.15 The decimal re-encoding functions

These functions enable writing code that handles external data in one of the two alternate encoding schemes 754R specifies for decimal floating types, yet otherwise remains independent of the implementation's choice of encoding scheme.

7.12.15.1 The decode_dec functions

Synopsis

```
#define __STDC_WANT_DEC_FP__
#include <math.h>
_Decimal64 decode_decd64( dec64_decencoding_t x);
_Decimal32 decode_decd32( dec32_decencoding_t x);
_Decimal128 decode_decd128( dec128_decencoding_t x);
```

Description

The decode_dec functions decode their argument from the decimal encoding scheme for decimal data.

Returns

The decode_dec functions return the decoded representation of x.

7.12.15.2 The encode_dec functions

Synopsis

```
#define __STDC_WANT_DEC_FP__
#include <math.h>
dec64_decencoding_t encode_decd64(_Decimal64 x);
dec32_decencoding_t encode_decd32(_Decimal32 x);
dec128_decencoding_t encode_decd128(_Decimal128 x);
```

Description

The encode_dec functions encode their argument into the decimal encoding scheme for decimal data.

Returns

The encode_dec functions return the encoded representation of x.

7.12.15.3 The decode_bin functions

Synopsis

```
#define __STDC_WANT_DEC_FP__
#include <math.h>
_Decimal64 decode_bind64( dec64_binencoding_t x);
_Decimal32 decode_bind32( dec32_binencoding_t x);
_Decimal128 decode_bind128( dec128_binencoding_t x);
```

Description

The decode_bin functions decode their argument from the binary encoding scheme for decimal data.

Returns

The decode_bin functions return the decoded representation of x.

7.12.15.4 The encode_bin functions

Synopsis

```
#define __STDC_WANT_DEC_FP__
#include <math.h>
dec64_binencoding_t encode_bind64(_Decimal64 x);
dec32_binencoding_t encode_bind32(_Decimal32 x);
dec128_binencoding_t encode_bind128(_Decimal128 x);
```

Description

The encode_bin functions encode their argument into the binary encoding scheme for decimal data.

Returns

The encode_bin functions return the encoded representation of x.