

Proposal for C2x WG14 N2124

Title: FE_TONEARESTFROMZERO
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Proposal category: New features
Target audience: IEC 60559 implementers and users

Abstract: This proposal addresses issues raised by Joseph Myers in SC22WG14.14586. IEC 60559:2011 defines five rounding-direction attributes, the four in the previous version of the floating-point standard, and that are supported in C11, plus another one for to-nearest rounding that rounds ties away from zero. IEC 60559 requires all five for decimal (floating-point arithmetic), but for compatibility reasons requires only the original four for binary. However, the new fifth rounding direction for binary is defined and allowed in IEC 60559 and is supported in the RISC V architecture. TS 18661-2, which has been proposed for C2x, includes support for all five rounding directions for decimal floating-point arithmetic. The following proposed changes for C2x specify an optional fifth rounding-direction macro (for to-nearest rounding with ties away from zero) for arithmetic with standard floating types.

Prior art: RISC V architecture
<https://www2.eecs.berkeley.edu/Pubs/TechRpts/2014/EECS-2014-54.pdf>

Proposed changes:

In 7.6, add a macro to the list:

Each of the macros

```
FE_DOWNWARD
FE_TONEAREST
FE_TOWARDZERO
FE_UPWARD
```

where the new macro is

```
FE_TONEARESTFROMZERO
```

In F.3 (as proposed in TS 18661-1), change:

[9] The macros (7.6) **FE_DOWNWARD**, **FE_TONEAREST**, **FE_TOWARDZERO**, and **FE_UPWARD**, which are used in conjunction with the **fegetround** and **fesetround** functions and the **FENV_ROUND** pragma, represent the IEC 60559 rounding-direction attributes `roundTowardNegative`, `roundTiesToEven`, `roundTowardZero`, and `roundTowardPositive`, respectively.

to:

[9] The macros (7.6) **FE_DOWNWARD**, **FE_TONEAREST**, **FE_TOWARDZERO**, **FE_UPWARD**, and **FE_TONEARESTFROMZERO**, which are used in conjunction with the **fegetround** and **fesetround** functions and the **FENV_ROUND** pragma, represent the IEC 60559 rounding-direction attributes `roundTowardNegative`, `roundTiesToEven`, `roundTowardZero`, `roundTowardPositive`, and `roundTiesToAway`, respectively. Support for the `roundTiesToAway` attribute for binary floating-point arithmetic, and hence for the **FE_TONEARESTFROMZERO** macro, is optional.

In 5.2.4.2.2, add a footnote to the wording:

[8] The rounding mode for floating-point addition is characterized by the implementation-defined value of **FLT_ROUNDS**: 23)

-1	indeterminable
0	toward zero
1	to nearest

where the footnote is:

*) The value **1** is intended for any mode that rounds to nearest, regardless of how it rounds halfway cases.