

Subject: Distinction between model and physical numeric representations
 From: Van Snyder

1 Introduction

2 There is continuous confusion among Fortran users, but apparently not among processor developers,
 3 concerning the difference between model and physical representations of numbers, especially real num-
 4 bers. It would be helpful to draw the distinction explicitly instead of indirectly and obliquely, to move
 5 the descriptions of numeric models from Subclause 13.4 to Subclauses 4.4.1 and 4.4.2, and to insert a
 6 note in Subclause 7.1.4.2. The intent is that these editorial changes introduce no technical change.
 7 It may be desirable similarly to move most of Subclause 13.3 into the appropriate Subclause in Section
 8 4 when the BITS type is introduced.

9 2 Edits

10 Edits refer to 04-007. Page and line numbers are displayed in the margin. Absent other instructions, a
 11 page and line number or line number range implies all of the indicated text is to be replaced by associated
 12 text, while a page and line number followed by + (-) indicates that associated text is to be inserted after
 13 (before) the indicated line. Remarks are noted in the margin, or appear between [and] in the text.

14 [Editor: Insert the following after the second sentence in the first paragraph of 4.4.1 (before “Each such 36:13-14
 15 method..”), without starting a new paragraph:]

16 Each such representation method is described by a model. The physical representation of integers is
 17 not necessarily exactly the same as the model representation. There may be physically representable
 18 numbers that are not described by the model, but the processor shall be capable of representing every *Technical*
 19 number described by the model. The models are described using parameters that are determined by *change?*
 20 the processor so as to make each model best fit the corresponding physical representation used on the
 21 machine on which the program is executed. The model representation for an integer having value i is
 22 defined by

$$i = s \times \sum_{k=0}^{q-1} w_k \times r^k$$

23 where r is an integer exceeding one, q is a positive integer, each w_k is a nonnegative integer less than r ,
 24 and s is +1 or -1. The integer parameters r and q determine the set of model integers.

25 [Then start a new paragraph, and replace “Each such method” at the beginning of the next sentence by
 26 “Each model representation”.]

27 [Editor: Insert the following sentence before “The intrinsic function SELECTED_INT_KIND”.] 36:17

28 The radix r of the representation method is returned by the intrinsic function RADIX (13.7.93).

29 [Editor: Start a new paragraph at “The integer type...”.] 36:18

30 [Editor: Insert a full stop after “**representation method**”. Then insert the following without starting 37:29
 31 a new paragraph:]

32 Each such representation method is described by a model. The physical representation of real numbers
 33 is not necessarily exactly the same as the model representation. There may be physically representable
 34 numbers, and quantities that are not numbers, that are not described by the model, but the processor *Technical*
 35 shall be capable of representing every number described by the model. The models are described using *change?*
 36 parameters that are determined by the processor so as to make each model best fit the corresponding
 37 physical representation used on the machine on which the program is executed. The model representation
 38 for a real number having value x is defined by

$$x = \begin{cases} 0 \text{ or} \\ s \times b^e \times \sum_{k=1}^p f_k \times b^{-k} , \end{cases}$$

1 where b and p are integers exceeding one; each f_k is a nonnegative integer less than b , with f_1 nonzero;
 2 s is $+1$ or -1 ; and e is an integer that lies between some integer maximum e_{\max} and some integer
 3 minimum e_{\min} inclusively. For $x = 0$, its exponent e and digits f_k are defined to be zero. The integer
 4 parameters b , p , e_{\min} , and e_{\max} determine the set of model floating point numbers.

5 [Editor: Insert the following sentence before “The intrinsic function SELECTED_REAL_KIND”.] 37:32
 6 The radix b of the representation method is returned by the intrinsic function RADIX (13.7.93).

NOTE 7.8 $\frac{1}{2}$

124:46+

The type and type parameters of the result of a numeric operation are those of the representation method of model numbers (4.4.1, 4.4.2). The machine representation of the result of an operation is not specified (1.4). It may be the same as the machine representation of objects of a different type and kind from the model representation specified here, or a machine representation that does not correspond to the model representation of objects of any type and kind. The result of a particular operation, with operands of identical types, kinds and machine-represented values, at a single point or several points in a program, or at different instants during execution of the program, need not have the same machine representation or machine-represented value. For operations having results of real or complex type, it is recommended that the machine representation of the result of an operation have range and precision not less than the range and precision of the model representation corresponding to the type and kind specified here.

Should this sentence be removed?

7 [Editor: Replace the normative text of 13.4 (but not Note 13.4 by the following:)] 293:8-23
 8 Except for the NEAREST function (13.7.84), the numeric manipulation and inquiry functions are de-
 9 scribed in terms of models (4.4.1, 4.4.2) for the representation and behavior of numbers on a processor.