ISO/IEC JTC1/SC22/WG9 N405
Recommendation on ISO/IEC 13813 from the UK
6 June 2002

Note from the Convener: This report is provided in response to WG9 Action Item 40-2. It is being circulated to WG9 participants for information prior to the forthcoming June 21 meeting of WG9. In accordance with WG9 Action Item 40-3, it is forwarded to the ARG for further consideration.

Recommendation on ISO/IEC 13813 from the UK

The standard ISO/IEC 13813 entitled generic packages of real and complex type declarations and basic operations for Ada (including vector and matrix types) will soon be up for review. This note reviews the background to the development of the standard and makes a recommendation that the standard be revised.

Background

The Numerics Working Group of WG9 met many times during the period when Ada 95 was being designed and produced a number of standards. They were faced with the problem of whether to produce standards based on Ada 83 (87 in ISO terms) or whether to base them on Ada 95 or subsume them into Ada 95. One dilemma was of course that although Ada 95 was on the way nevertheless Ada 83 was expected to continue in use for many years.

The standards are

11430: Generic package of elementary functions for Ada.

11729: Generic package of primitive functions for Ada.

13813: Generic packages of real and complex type declarations and basic operations for Ada (including vector and matrix types).

13814: Generic package of complex elementary functions for Ada.

11430 and 11729 are mentioned for completeness. They were published in 1994. They were based entirely on Ada 83 and their facilities are provided in the Ada 95 core language. The elementary functions, 11430, became the package Ada.Numerics.Generic_Elementary_Functions and the primitive functions, 11729, became the various attributes such as 'Floor and 'Ceiling, and 'Exponent and 'Fraction. These two standards were withdrawn recently and need no further mention.

The other two standards, 13813 and 13814, were published in 1998 and will soon be up for review at the end of their five year period. Three possible fates can befall a standard when it is reviewed. It can be withdrawn, revised or confirmed.

In the case of 13814, the functionality is all incorporated into the Numerics Annex of Ada 95 as the package Ada.Numerics.Generic_Complex_Elementary_Functions. There are a few changes in presentation because the Ada 95 package uses the generic package parameter feature which of course did not exist in Ada 83. Nevertheless there seems little point in continuing with 13814 and so at the Leuven meeting of WG9 it was agreed to recommend that it be withdrawn.

However, the situation regarding 13813 is not so clear. Some of its functionality is included in Ada 95 but quite a lot is not. The topics covered are (1) a complex types package including various complex arithmetic operations, (2) a real arrays package covering both vectors and matrices, (3) a complex arrays package covering both vectors and matrices, (4) a complex input-output package.

The complex types package (1) became the package Ada.Numerics.Generic_Complex_Types and the input-output package (4) became Ada.Text_IO.Complex_IO. However, the array packages, both real and complex, were not incorporated into the Ada 95 standard.

At the Leuven meeting, it was agreed that 13813 should not be withdrawn without further study. The UK was asked to study whether small or large changes are required in 13813 and to report back. The Ada Rapporteur Group would then decide whether the functionality should be included in a future revision or amendment to Ada 95.

This is the report from the UK.

Recommendation

It is recommended that 13813 be revised so that it only contains the functionality not included in Ada 95.

The revised standard should contain two generic packages namely Ada.Numerics.Generic_Real_Arrays and Ada.Numerics.Generic_Complex_Arrays.

There should also be standard non-generic packages corresponding to the predefined types such as Float in an analogous manner to the standard packages such as Ada.Numerics.Complex_Types and Ada.Numerics.Long_Complex_Types for Float and Long_Float respectively.

The text of the Ada specifications of the two generic packages should be essentially as given in the nonnormative Annex G of the existing standard 13813. (This Annex illustrates how the existing standard packages might be rewritten using Ada 95. There is an error regarding the formal package parameters which has been corrected in the revised text.)

There is an important issue regarding what should happen if there is a mismatch in the array lengths of the parameters in a number of the subprograms provided by the packages. For example if

```
function "+" (Left, Right: Real_Vector) return Real_Vector
```

be called with parameters such that Left'Length /= Right'Length.

The existing standard raises the exception Array_Index_Error which is declared alone in a package Array_Exceptions. The nonnormative Annex G shows this exception incorporated into the package Ada.Numerics thereby producing an incompatibility with the existing definition of Ada.Numerics.

We considered four possibilities regarding this exception

1) Add Array_Index_Error to Ada.Numerics as in Annex G.

2) Place Array_Index_Error in a new child package such as Ada.Numerics.Arrays.

3) Eliminate Array_Index_Error and raise Constraint_Error instead.

4) State that the behaviour with mismatched arrays is implementation-defined.

We concluded that

Option (1) is undesirable because of incompatibility.

Option (2) is feasible but one ought then to place the generic packages themselves into this package so that they become Ada.Numerics.Arrays.Generic_Real_Arrays and Ada.Numerics.Arrays.Generic_Complex_Arrays. This nesting is considered cumbersome.

Option(3) gives the same behaviour as similar mismatching on predefined operations and although losing some specificacity has practical simplicity.

Option (4) is disliked since gratuitous implementation-defined behaviour should be avoided.

We therefore recommend Option (3) that Constraint_Error be raised on mismatching of parameters.

If the Ada95 standard itself be revised at some later date then consideration should be given to incorporating the functionality of the revised 13813 into the Numerics Annex.

Proposed text

The proposed normative text of the revised standard is distributed separately as N404, Working Draft, Revision of ISO/IEC 13813. Note that the non-normative rationale section remains to be completed and that consequently the bibliography might need alterations to match.

Acknowledgment

We acknowledge the valuable assistance of Donald Sando, the editor of the original standard, in the preparation of this recommendation.

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