

To: John Hill

From: X3J3/Parallel Subgroup (Keith Bierman, Maureen Hoffert)

Date: August 3, 1992

Subject: US Parallel Processing Activities

At the WG5 Victoria meetings last week, resolution V3 was passed that states:

V3. Activities on Parallel Computing

That WG5 requests the US delegation to SC22 to report to SC22 at its August 1992 meeting on developments of Fortran for parallel computing, and requests Maureen Hoffert to provide the delegates with relevant background information.

X3J3 has formed a new subgroup, X3J3/Parallel to track parallel processing efforts as they relate to Fortran. This subgroup will act as a liaison where useful and will propose syntax and semantics for future Fortran standards as appropriate. WG5 and X3J3 believe that it is important for the US delegation and SC22 to understand that this work is progressing and that this work impacts and is influenced by Fortran 90.

Currently there are three US/International parallel processing efforts:

1. X3H5
2. HPPF
3. Posix.4

X3H5:

An ANSI committee currently is pursuing three development efforts:

1. for a Language Independent Standard
2. for a Fortran 90 binding
3. for a C language binding.

The term binding is used in the ISO GLB (Guidelines for Language Bindings) sense, which implies adding syntax and semantic extensions to the base language where appropriate.

X3H5 has made a great deal of progress on its model document. The model document covers virtual shared memory MIMD (multiple instruction, multiple data) machines. Such machines have been available in the market place by a number of vendors and supported by a number of software products for a number of years. The model reflects several years of industry experience. Work on the binding initially was a secondary effort initially. The primary effort of X3H5 was focused on a binding to FORTRAN 77. This resulted in a proposal that has since been withdrawn since it was completed after the adoption of the Fortran 90 ISO standard. It is hoped that progress can be made quickly on the model.

X3H5 has a mixture of commercial, academic and user participation. Their working deliberations are largely electronic; observers worldwide have had access to the documents as they evolve.

At the May 1992, meeting 121 of X3J3, X3J3 voted to recommend to X3 that X3 accept the X3H5 proposal for developing a binding to Fortran 90 that will include new syntax and semantics to Fortran; and that X3J3 should be a coordinating liaison for such work. It is X3J3's intent to work closely with X3H5 to coordinate the development of the work and to assure that such work is well integrated into Fortran 90 as a whole.

HPFF:

HPFF (High Performance Fortran Forum) is a cooperative effort of users, academic and commercial groups operating outside of ANSI, ISO and IEEE procedures. The first meeting of this group was held in January 1992.

At the second HPFF meeting in April, Fortran 90 was selected as the base language for the development of HPF (High Performance Fortran). The goal is to have a language specification completed by December 1992 (in one year of work). They expect that there will be implementations available within the following year. FORTRAN 77 was considered and rejected. There are more than 600 people who access the electronic discussion groups worldwide.

The design of the language is based on current implementations, products already in the marketplace, and on active research at key institutions. Key features of Fortran 90 that are particularly of interest to HPF are: the array syntax; type declaration syntax; interface blocks and modules.

HPFF has focused on "data parallel" applications which map well into distributed memory system designs. The principle language elements include distribution directives which use Fortran 90 comment syntax. There are also proposals for adding some additional Fortran syntax in the form of a FORALL statement that had been in early drafts of the Fortran 90 standard. There are proposals for adding a number of new intrinsic and library routines, and parallel input/output features.

POSIX.4

POSIX, the IEEE programming environment work on "real time extensions" project is not normally thought of as a parallel programming standard. However, its model of "threads", "lightweight processes" and "processes" provides a control parallelism common in operating systems, databases and window systems on shared memory machines. Currently it is targeted to the C programming language. Fortran 90 provides virtually all the functionality required to provide full access to this mode of programming. There may be possible future Fortran extensions that support the concept of "thread local storage".

The work of POSIX.4 is fairly advanced and represents the work of several vendors and users. Implementations have begun to appear in the marketplace.

Final Remarks:

The HPFF, X3H5 and POSIX groups have all had some international participation. There is a European HPFF group that has been meeting for coordination with and discussion of the US HPFF work. All groups represent different models of computation and it is likely that more such efforts may continue to appear as Parallel Processing systems become more common and move from a market niche into the mainstream of computing.

It is critical to the success of such efforts to capture a fraction of existing applications. Thus probably all five of the binding techniques defined in the ISO GLB will be required.

Because of the growing importance of Fortran 90 and because of the language support that Fortran 90 supplies for parallel computing, Fortran 90 will be the first language of choice for many such efforts.

Some reasons for the importance of Fortran 90 are:

1. computationally intense applications have traditionally been coded in Fortran, and hence the transition to Fortran 90 is relatively easy.
2. Fortran provides a rich array syntax amenable to both application and system requirements.
3. Fortran 90 module facility provides a mechanism that helps encapsulate the addition of new functionality.

While it is important to be responsive to the needs of these communities, it would be a mistake to force all such efforts into the Fortran language directly. Some of these approaches have an unknown longer term utility than others.

At the summer 1992, WG5 meetings, WG5 requested that X3J3 be the primary development body of the next revision of Fortran, provided that an I-project can be adopted for such work. It is the intent of X3J3 to monitor, work with, and hopefully influence such groups as described above so that there is as much coordination as possible and so that all such work can coexist effectively.

X3J3/Parallel subgroup intends to work with parallel processing groups in the US, ISO and world at large, including groups such as HPPF which is outside the official standards arena.