ANDF Quarterly Report, 1Q93

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The ANDF Advanced Technology program within the OSF RI has made considerable progress since its inception in June 1992. This report will highlight the accomplishments since the beginning of 1993.

The program's rationale is presented in § 1, staffing in § 2, and our strategy in §3. The remaining sections summarize each project.

1. Program Rationale

The ANDF Advanced Technology program provides benefits to several constituencies in the computing industry.

End Users

End users benefit from ANDF because it simplifies their model for acquiring software. They derive direct benefits not only from the simplified distribution of an application, but also from the knowledge that a uniformly portable version of the application is being installed on each of their target platforms, thereby assuring a consistent "look and feel" for the application at each of these sites.

Ultimately, ANDF enables end users to procure new hardware architectures without invalidating their very large investment in existing software. Without some solution to distributing software in a portable format, the promise of open systems will fail when faced with the realities of software lock-in.

ISVs

ISVs benefit from ANDF because it provides a rigorous portability framework. Applications developed using the ANDF portability techniques have the potential for being installed on any target architecture which has the appropriate ANDF Installation environment. This increases the installed base for ISV's. ANDF not only specifies applications in an Architecture Neutral representation, but also in a version neutral representation. Thus application are no longer tied to either a specific architecture nor a specific version of an operating environment.

Vendors

ANDF allows vendors to continue to innovate in both hardware and software, without having to always be concerned about binary compatibility. ANDF is focussed on compatibility at the Application Programmer Interface (API) level. The Application Binary Interface (ABI) concerns are handled solely by the ANDF Installer.

2. Strategy

The ANDF Advanced Technology Program Strategy is geared toward making ANDF a widely available and widely accepted specification. This is to be accomplished through implementation of the following:

- Insure completeness of the specification and provide vendors the option of reusing their own compiler by designing a bridge from ANDF to existing compilers.
- Develop verification technology for ANDF so that vendors/ISVs/End Users can have increased confidence that an installer is compliant to the specification.
- Extend ANDF to parallel languages and hardware architectures.
- Write position papers on the technology to allow the community to become better informed about ANDF.
- Collaborate with vendors and DRA to facilitate technology transfer.

3. Staffing and Finances

During the first quarter of 1993, the ANDF Advanced Technology Program had a total staffing of seven Research Engineers - four in Cambridge and three in Grenoble. They are presently supported through a combination of Industrial and Research support, as follows:

- Industrial Support from OSF, HP, USL, and Microsoft
- Research Support from Esprit, DARPA and OSF.

The ANDF Advanced Technology program has a number of projects, each staffed by one or more Engineers. These are described below.

4. The GANDF project

The goal of the GANDF project is to develop a bridge technology from ANDF to existing compiler technologies.

This is accomplished by developing a prototype technology to bridge between ANDF (as described in the ANDF Specification) and GCC, which is a well documented, freely available, compiler technology. If successful, this prototype will demonstrate the feasibility of re-using vendors' existing compiler back-ends to install ANDF applications. Because this is a familiar technology, it reduces the cost to develop and also improves the time-to-market for an ANDF installer. In addition, installed applications get the full benefit of the vendor's mature optimization technology, assuring competitive performance.

The GANDF project allows OSF to work with vendors to demonstrate these cost savings and performance characteristics. From the GANDF results, it should be easy to predict the cost of developing a similar bridge to any existing technology.

During the first quarter of 1993, we demonstrated the generality of our approach by developing six GANDF installers for the following hardware/software combinations:

- Intel 486 / SCO
- Intel 486 / OSF/1
- IBM RS-6000 / AIX

- HP PA-RISC / HP/UX
- Sun Sparc / SunOS
- DEC MIPS / Ultrix

An additional prototype was built for the DEC Alpha. However, only limited development has been done due to the immaturity of the GCC port on the Alpha. This will be the next major prototype developed under the GANDF project.

Each of these prototypes (except the Alpha) has demonstrated the ability to pass the Plum-Hall C-Language Conformance Suite. This suite exercises all of the C language features as described in ANSI/ISO C.

However, while we have achieved preliminary success with conformance, we have not yet achieved performance parity. Performance characteristics were measured using the SPEC-INT (C-Language) subset of the SPEC Benchmark suite. Of those platforms which successfully install and execute these tests, each exhibits performance approximately 20% slower than the GCC compiler on which GANDF is based.

During the second and third quarters, we plan to achieve parity between the performance of GANDF and GCC or explain why parity is not possible. The results of this work may be reflected in a set of proposed changes to either GANDF, the ANDF specification, or to the current DRA Producer implementation. We also plan to demonstrate that the GANDF installers are capable of handling large application codes in ANDF, such as Wingz and the ANDF C Producer (both already running on the Intel 486).

Later in the year, we plan to examine the possibility of retargeting existing language parsers as front-ends for ANDF. This would provide further evidence that the ANDF specification is complete and not tied to artifacts of any single implementation. It will also provide a complete reference implementation that can be freely circulated in the research community and provided to procurement bodies such as NIST.

5. The Validation Project

The goal of the Validation project is to contribute to a complete and verifiable specification for ANDF.

This project involves a combination of testing and development efforts. The testing effort includes building large, well known, commercial applications such as WingZ and Oracle. Both of these applications claim to stretch the capabilities of C compilers, so success will be well recognized in the ISV community.

The project will continue to subject each delivery of the ANDF technology to the recognized Language and System test suites which verify that the Language and API features are supported as required by their published standards. The suites currently in use are Plum-Hall and Perennial (NIST) suites for the C Language, and VSX for XPG3. As the API support grows, the test suite will grow accordingly.

The Validation project is also responsible for developing a validation suite for ANDF installers, derived from the ANDF specification itself, rather than from the ANDF issued by any one Producer implementation. For Producer testing, an ANDF interpreter will be developed, which will utilize ANDF versions of the standard Language/API test suites to verify that a given producer has issued correct ANDF in the Abstract, as opposed to ANDF which is only correct for a subset of target platforms.

All of this work will be done in collaboration with other related work that is being done as part of the Esprit-funded GLUE project, in order to meet the needs of projects utilizing the ANDF specification to create either ANDF Producers or Installers.

During the first quarter of 1993, the OSF Research Institute in Grenoble hosted the first Esprit GLUE Project Management Review meeting. In addition, the paper *ANDF Validation Suites Specification* was delivered to the GLUE partners.

The VSX (XPG3) suite has been successfully added to the set of ANDF test suites. The initial results indicated a better than 90% success rate. A few discrepancies in the API support were detected and fixed.

The ANDF technology has successfully built two major and three minor components of the Oracle system, representing approximately 500,000 lines of code. These builds were on two different platforms, each using the ANDF Technology as a “native” compiler replacement. Additional work must be done to the Oracle framework to make it a true ANDF application. This project will prepare a report outlining this work in detail.

During the second quarter, we plan to reapply our ANDF test suites and applications to a new release of the technology, presently scheduled to arrive in May from DRA. As the technology is now maturing, we plan to investigate how to quantify the performance and quality of compilation via that ANDF path versus compilation via standard, commercial compilers. We will also investigate how we can take advantage of the recent agreements by leading vendors regarding a common API.[1]

6. The Documentation Project

The goal of the Documentation project is to document and explain the technical issues related to ANDF.

It is important that the ANDF specification and reference implementation have companion documentation which makes the use of ANDF accessible to all of the potential ANDF constituency. This project has produced a number of documents geared toward this more general audience. There are documents designed to assist ISV's in adapting their application code to the ANDF portability framework. These documents should allow ISVs to participate more actively in the ANDF program. There is a document which does a detailed analysis of the nature of Software Protection available through ANDF, an issue of great concern to ISVs who view their source code as their major asset. There is a document which explains in detail the analysis and engineering techniques used to create a "bridge" between ANDF and an existing code generator technology. In addition to these documents, the documentation project has also made the appropriate DRA documents available in order to present a more complete view of ANDF. All of these papers have been collected into a single volume available from the RI and entitled ANDF Collected Papers, Volume 1.

To simplify access to this material, we have collected these recent papers, along with DRA papers and papers of historical interest written earlier at OSF into a single volume entitled ANDF Collected Papers, Volume 1. This volume contains the following RI monographs:

- The ANDF Technology Program at the OSF RI
- Porting to ANDF

1. An announcement regarding the intention to support a common API was made by SUN, SCO, USL, HP and IBM at the March Uniforum.

- Protecting Source Code with ANDF
- GANDF: A GCC-based ANDF Translator

Additional papers are currently in preparation and will be distributed in Volume 2. These include:

- ANDF Validation Suites Specification (V1.0)
- Building ANDF applications
- GANDF: Status and Design
- Using the ANDF Compiler Technology for X/Open Verification of an OSF/1 Platform
- Using the ANDF Compiler Technology to Port Oracle — A Progress Report

In addition to documents, this project has also set up a more general email discussion group, in order to increase the awareness of ANDF to a wider audience.

7. Technology Extensions

This project is investigating extensions to ANDF for both parallel hardware and parallel languages, in order to accommodate the needs of the High Performance Computing community.

This project is investigating the needs of languages such as ISO Fortran (Fortran-90) and the newly published High Performance Fortran specification. In addition, the project will be looking into the requirements for systems like the Intel Paragon. The result will be a report on the required changes to ANDF and a prototype implementation incorporating these changes.

The project is presently in the planning stages.

8. Technology Transfer

This project has a goal of making the ANDF Technology accessible to a variety of audiences.

This project will work with the System Vendors to expose them to ANDF, encourage them to create ANDF products (especially Installers) and support

them in the early stages of that process. The ANDF Advanced Technology project has received funding from HP and Microsoft in order to investigate various aspects of the technology of interest to them. HP is particularly interested in the Installer Technology, with the emphasis on accessibility and performance. Microsoft is interested in the applicability of ANDF to an API other than the currently supported ANSI C/POSIX/XPG3 APIs. This project has also continued to collaborate with USL and DRA in trying to reach the ISV community with ANDF. A 1/2 day intensive seminar on ANDF was presented to DEC in January, and we are now collaborating with a DEC Advanced Development project which is looking into interfacing ANDF with their in-house proprietary code generator technology.

This project is looking to work with standards bodies to encourage the adoption of an ANDF standard. The results of the Validation Project will determine the appropriate timing to promote ANDF as a standard.

This project also plans to talk with major procurement bodies, particularly governmental, to encourage creating mandates for ANDF in major procurements, since this would simplify the procurement process, and encourage more “off the shelf” acquisitions rather than specialized contracts, which are much more expensive.

This project participated in Esprit GLUE meetings whose goal was to define a technology transfer plan. OSF has the advantage of having many system vendors in its membership, and is particularly well positioned for having a major role in this effort.

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