

# Fortran

## SOURCE

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**Lahey**<sup>®</sup>  
Computer Systems, Inc.  
MOVING CODE FORWARD™

*Specializing in  
Language Systems  
Since 1967*

## Lahey Partners with PathScale

Lahey Computer Systems, Inc., has partnered with PathScale, Inc., developer of innovative technologies for increasing the performance of Linux clusters, to 1) resell PathScale's 64-bit Linux EKOPath Compiler Suite and 2) port the 64-bit Linux EKOPath Compiler Suite to Windows Server 2003 x64 Editions. Both AMD64 and EM64T architectures are supported by the 64-bit Linux Compiler Suite and will be supported by the Windows-64 port. Researchers, scientists, and engineers recognize PathScale's EKOPath Compiler Suite as the compiler collection of choice for achieving the highest performance from their 64-bit Linux systems. Plans are for the Windows-64 Compiler Suite to achieve the same levels of performance. The EKOPath Compiler Suite includes C, C++, and Fortran 95 language systems, and supports 64- and 32-bit x86 compilation.

Scott Metcalf, president and CEO of PathScale, had this to say about our partnership: "Lahey is a well-established compiler company with a great reputation. Organizations have a significant investment in code, and the combination of Lahey's expertise and PathScale's technology will enhance the value of their applications as companies move forward to 64-bit computing. We believe our collaboration will significantly benefit the market for the x64 editions of Windows Server 2003, and with the future release of the *Compute Cluster Edition*, high performance computing will become more affordable and available to a broader range of organizations and businesses."

The PathScale EKOPath Compiler Suite shares its heritage with the well-known and mature SGI compiler suite. The PathScale EKOPath Compiler Suite has been optimized for both the AMD64 and EM64T architectures and has the world's most sophisticated optimization infrastructure. The Compiler Suite provides superior performance across both floating-point- and integer-intensive applications. Application developers targeting 64-bit Linux servers will see immediate performance improvements by building with the PathScale compilers.

The Linux PathScale EKOPath Compiler Suite is licensed as a subscription service that includes all major and minor product enhancements, bug fixes, performance improvements, and access to customer support. The subscription is licensed on a per developer basis. When purchased from Lahey, the annual subscription fee for the entire Linux EKOPath Compiler Suite is US\$1,420, for EKOPath Fortran, US\$1,040, and for EKOPath C/C++, US\$565. Lahey's prices are approximately 5% less than suggested retail.

General availability of the command-line Windows-64 Lahey/PathScale EKOPath Compiler Suite is planned for 3Q05 with Visual Studio integration to follow. Pricing is not yet decided. Lahey will encourage Win32 Fortran customers to migrate code to this Windows-64

*(Continued on page 5)*

## Programming Services

Lahey offers a full range of programming services.

We can bring your code up on another platform, parallelize it, add a user interface to it, make it easier to use, make it accessible over the Internet through a web browser, make it read from and write to a database, and more. We can work with your ideas and designs to create new code and applications. We can write COM objects. We can code in Fortran, Fortran for .NET, C, C++, C#, Visual Basic, assembly, and probably just about any other language. We can translate your code from one language to another.

John Ferritto, senior engineer at Karagozian & Case, wrote, "Karagozian and Case tasked Lahey Computer Systems to convert a large program originally written in Visual Basic 6 to Fortran. The goal was to make the coding more portable and create a DLL to permit the program to be called by other programs. Lahey did a great job in converting our code and creating the DLL. The program is now able to be called by other programs with results that are essentially identical to the results from the original program. In the process, the execution speed has increased. The work was accomplished promptly, in a most professional manner, and at an acceptable cost. Lahey programmers were highly skilled, able to follow the original code logic, and functioned independently with a minimum of guidance. We are pleased to recommend Lahey."

We can move your code forward. Call us at 800-548-4778 or 775-831-2500, or send e-mail to [sales@lahey.com](mailto:sales@lahey.com). ■

## Dear Fortran Programmers,

64 bits! Can you believe it! I can, but only with a little bit of awe. Motherboards, PC's, and software are available today. As you have seen on page 1, Lahey is offering a 64-bit Linux Fortran Language System that we have validated by running our test suite of 8,000 tests.

### CEO's Letter



September 1957. I was born as a programmer when I learned to program ILLIAC I at the University of Illinois. ILLIAC I, a vacuum tube computer, had 1,024 40-bit words (2 instructions/word), Williams memory, a drum, and paper tape i/o. Floating-point was implemented via software and you had to have permission to use it!

April 1959. GE Computer Dept, Tempe, AZ. Fellow employee, Marcia Mooney taught me FORTRAN. (IF( SENSE LIGHT n), IF( SENSE SWITCH n), ...) From this point on, Fortran and I became best friends.

November 1975. I began receiving royalties for the first FORTRAN 77 implemented anywhere. I implemented the language system on the 36-bit Honeywell-Bull 636 using the DTSS operating system. After working as a programmer for 16 years, I thought I was semi-retired, destined to cash royalty checks for the rest of my life. This delusion existed in spite of appreciating 16 years of computer evolution and knowing that today's technology is done in by tomorrow's evolution.

In 1981, maybe 1980. I installed an 8080 in an office I had built in our garage. The 8080 was an 8-bit chip using CPM and could address 64K memory (I am concerned about remembering dates and size correctly). I experimented and decided that I couldn't fit a meaningful FORTRAN 77 compiler in that much memory. Also, there was no hardware floating-point. I didn't pursue the project. However, the 8080 was a wake up call; I realized my semi-retirement was over.

1982. IBM brings the 8086 PC to market. I ordered 2 clones, one for me, one for Bruce Bush. I implemented the compiler and wrote the language manual; Bruce was responsible for the run-time package; Kory Hamzeh, a senior at Rolling Hills High School, Palos Verdes, CA, programmed the intrinsic functions. Guy Ceragioli, Marketing & Sales, plus Karen May worked at all the detail for making it all happen. Lahey licensed the first language system to Bill Brackett during September 1984.

1987. True story. After I gave a talk somewhere in Nova Scotia, a programmer told me about his migration to the 286. Before the 286, he paid for execution time on a Cray at overnight rates. He purchased a 286 system with extended memory and ran the same jobs overnight! Everything was the same except his costs.

1988. Lahey brought to market F77L-EM/32 for Intel's 386. The 386 was the first chip that allowed all mainframe programs to be ported to the PC. Ok, execution speed needed to be improved.

My point in this review of the past. Look how far we've come. From the Fortran point-of-view, I do not see a 128-bit chip (I've been wrong before); database applications may create a demand. When? Plot the points on a graph and you can tell me.

Keep up the good work,

Tom

P.S. I should have pursued a FORTRAN 77 on the 8080. Even if I hadn't finished, it would have served as the basis for F77L and we would have been to market earlier. ■

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**Fortran**  
SOURCE

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# MATFOR Numerical and Visualization Libraries

MATFOR is a set of numerical and visualization libraries developed to accurately perform computation and dynamically visualize data. From wave propagation to fluid dynamics and solid mechanics, by adding a few lines of MATFOR code to your program, you can easily visualize your computing results, perform run-time animations, even produce a movie presentation file as you execute your program. The MATFOR Numerical and Visualization Libraries are available with LF Fortran Enterprise and Professional editions.

## MATFOR Features

**Advanced 2D/3D visualization:** MATFOR's graphics library contains high-level graphical procedures that support the following plots: x-y, vector, contour, surface, isosurface, and more. This variety of graphical procedures allows you to use the representation most appropriate for your simulation model.

**Data analysis:** MATFOR's Data Viewer is organized in spreadsheet format and provides a convenient platform for data management, filtering, and analysis.

**Instant visualization:** MATFOR's Graphics Viewer displays high-quality graphs with no need for Windows programming and graphics initialization. This visualization capability enables you to display graphs instantly with only a couple of lines of programming.

**Real-time animation:** MATFOR's Graphics Viewer cooperates with the Data Viewer to display intermediate data during program execution. This real-time program monitoring mechanism significantly reduces the time and effort you spend on program development. The Graphics Viewer allows you to pause an animation, view the current data using the Data Viewer, and examine any aberrations.

**Movie-like presentation:** MATFOR's mfPlayer transforms computed data into movie-like animations.

**Matlab-like syntax:** MATFOR's mfArray is the basis of MATFOR programming. This fundamental data structure provides dynamic data typing and dimensioning.

**Numerical Library:** MATFOR's numerical procedures are designed to be intuitive and simple to use. The library contains useful linear algebraic functions.

Need to display your results graphically or create a user interface? Have trouble deciding whether to use *Winteracter*, *WiSK*, *GINO*, *MATFOR*, *Fortran for .NET*, or something else? Give us a call at 800-548-4778 or 775-831-2500, or send e-mail to [sales@lahey.com](mailto:sales@lahey.com). We'll help you identify the best solution for your application.

## Sample MATFOR program and graphical results

```
PROGRAM Math
  USE fgl
  USE fml
  IMPLICIT NONE

  INTEGER, PARAMETER :: n=30
  INTEGER              :: i, j
  REAL                 :: z(n, n)

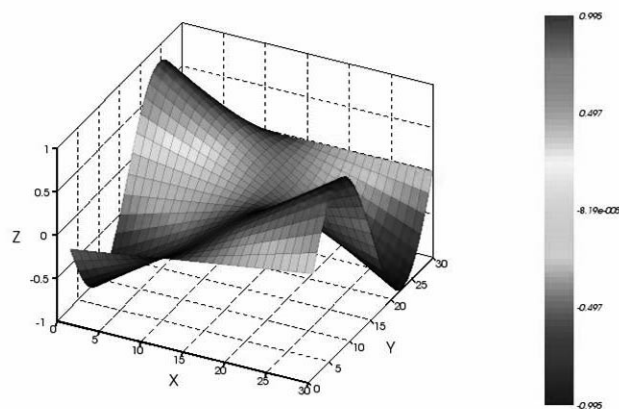
  ! Create data for plotting
  DO i = 1, n
    DO j = 1, n
      z(i, j) = ( 2.0*j/n - 1 ) * &
                SIN( 6.28*i/n )
    END DO
  END DO

  ! Convert z to mfArray using mf( z )
  ! Call msSurf for surface plot
  CALL msSurf( mf( z ) )

  ! Pause to display the graph
  CALL msViewPause( )

  STOP
END PROGRAM Math
```

Running the program produces the following display:



Order your LF Fortran + MATFOR bundle today. Call Lahey Sales at 800-548-4778 or 775-831-2500, or send e-mail to [sales@lahey.com](mailto:sales@lahey.com). For more product information please visit [www.ancad.com](http://www.ancad.com). ■

## News Briefs

### **Winteracter v6.1 Available**

Winteracter v6.1 is available from Lahey. Upgrades from any previous release are available.

Winteracter is a modern GUI toolset for the Fortran 90/95 programming language. It consists of various visual development tools and a substantial subroutine library. Versions are available for most Fortran 9x compilers.

### **LF Fortran v7.1.2 Patch Available**

LF Fortran v7.1.2 maintenance update for owners of v7.1 is now available. To update to v7.1.2, run Start > Programs > Lahey-Fujitsu Fortran v7.1 > Product Maintenance > Online Update. Alternatively, the traditional downloadable update program is available at [www.lahey.com/lf71updt.htm](http://www.lahey.com/lf71updt.htm). If you haven't updated since the initial release of LF Fortran v7.1, note that v7.1.2 includes the additional Fortran 95 procedures released with the v7.1.1 Enterprise and Academic Fortran for .NET compilers. LF Fortran v7.1.2 also fixes eight bugs.

### **LF95 Linux v6.2c Patch Available**

LF95 v6.2c maintenance update for owners of v6.2 is now available. You can download the patch from [www.lahey.com/lf9562proupdt.htm](http://www.lahey.com/lf9562proupdt.htm). Support for Red Hat v3 Enterprise is added and seven bugs are fixed, including the quad-precision problem.

### **GINO Graphics 6.0e Patch Available**

Visit [www.gino-graphics.com](http://www.gino-graphics.com) to download the GINO Graphics v6.0e patch.

GINO is a suite of portable graphics development tools aimed at scientific/engineering applications and contains over 700 routines available with an F90, C, Visual Basic, Delphi or .NET binding. ■

**Q:** I can use // to concatenate two character variables, but how do I concatenate two USTRINGS, i.e., concatenate two variables of type System%String when using the LF Fortran for .NET?

**A:** Use the Framework method String%Concat:

```
ustring3 = String%Concat (ustring1, ustring2)
```

**Q:** Does the Lahey Fortran compiler run on 64-bit machines using Linux?

**A:** We do not officially support LF95 on 64-bit machines but it will work on an Opteron if you compile with `-wa, --32`. This instructs the assembler to work with the 32-bit objects created by LF95.

In April 2004, Lahey began offering PathScale's EKOPath 64-bit Fortran Compiler for Opteron-based machines (and now for EM64T machines) running Linux. See our announcement for details: [www.lahey.com/path.htm](http://www.lahey.com/path.htm).

**Q:** My F77L-EM/32 and LF90 Fortran compilers and the executables created with them produce an Abnormal Program Termination error when run on Windows 2000 and XP. What do I do?

**A:** F77L-EM/32 and LF90 are not compatible with Windows 2000 and XP. (Note that these products did work on Windows 2000 until a recent security update.) There is no fix for this problem. The products and the executables they generate are limited to use on supported operating systems: DOS,

Windows 9x, Millennium, and NT®. Our current product, LF Fortran v7.1, is fully compatible Windows 2000 and XP.

**Q:** How do I port projects that call the Lahey Video Graphics Library routines to LF Fortran v7.1?

**A:** The WiSK graphics library included with PRO & Professional versions of Lahey products can be used to re-link programs written for Lahey's Video Graphics Library. See the LVGL.F90 file included with your Lahey product in the src

directory. See the "Graphics Interfaces" section in the online help file, `wisk.htm`, for further details.

Here are the LVGL routines defined in LVGL.F90: CIRCLE, FACTOR, FILL, GETPIX, GRINFO, GTEXT, ISKEY, IXKEY, NEWPEN, PLOT, PLOTS, SETPIX, WHERE.

**Q:** The Lahey compilers seem to accept some non-standard syntax. Can I configure the product so that errors or warnings are generated for all non-standard syntax?

**A:** Yes. To display warnings when source contains non-standard syntax supported by Lahey language systems, use the `-f95 compile option`. ■





# Lahey Partners with PathScale

(Continued from page 1)

Lahey/PathScale Fortran.

What about the Lahey/Fujitsu products? Lahey continues to maintain an excellent relationship with Fujitsu and plans to continue, for the foreseeable future, offering and supporting the Lahey/Fujitsu Fortran 32-bit language systems. There will be an upgrade path from the Lahey/Fujitsu to the Lahey/PathScale language systems.

For more information about the Windows-64 port or to order your Linux EKOPath subscription, please contact Lahey at sales@lahey.com, 800-548-4778, or 775-831-2500.

## **Pathscale EKOPath Compiler Suite Features**

### *Functional Components*

- GNU C/C++ front-end-compatible
- Compiler drivers compatible with GNU
- Fortran 95 with Cray/SGI extensions and OpenMP 2.0
- Pathdb command-line debugger
- Tuned libraries including ACML 2.5

### *AMD64-specific Capabilities*

- Support for inline assembly code
- Long address support
- Supports AMD64 ABI (x86-64)
- Utilizes full 64-bit ISA including SSE2/3DNow!™ and register sets
- Instruction scheduling for the AMD out-of-order core

### *EM64T-specific Capabilities*

- All SSE3 instructions available
- Single precision complex (except div/mult)
- Unaligned loads
- Instruction scheduling for the Intel EM64T core

### *Code Generation Optimizations*

- Control flow optimization
- If-conversion
- Instruction scheduling
- Global register allocation
- Loop unrolling
- Peephole optimization

### *Loop Nest Optimizer*

- Loop-caused dependency analysis
- Loop Interchange
- Cache Blocking
- Loop Fission
- Loop Fusion
- Outer loop unrolling
- Prefetching
- Scalar Expansion and Array Expansion
- Gather-scatter
- Pad arrays to reduce cache conflicts
- Vectorization (including SIMD)

### *C/C++ Binary and Source Code Compatibility*

- Source compatible at GNU 3.3.1 (or later)
- 100% binary interoperability, including name mangling
- Mix and match GNU and PathScale compiled objects

### *Fortran Binary and Source Code Compatibility*

- Source compatible Fortran 77/90/95 with Cray/ extensions including full pointer support
- OpenMP 2.0 support
- All common Fortran 77 extensions for compiling “dusty deck” code
- Links with g77 compiled libraries
- Custom libraries included, including libm and ACML2.5
- Big-endian/Little-endian Fortran I/O

### *Debugger (Pathdb) Compatibility*

- Well formatted printing of Fortran variables, arrays, expressions
- Understands Fortran 77 and 90 types, and expression operators
- Properly prints standard C++ templates, maps, vectors, lists and dynamic types
- Gdb-compatible commands; works with GNU-compiled code
- Step backward capability

### *Global Scalar Optimization, Pre-optimizer*

- Goto conversion
- Loop normalization
- Alias analysis (flow-free and flow-sensitive)
- Tail recursion elimination
- Dead store elimination
- Induction variable canonicalization
- Copy propagation
- Dead code elimination

### *Global Scalar Optimization, Optimizer*

- Partial redundancy elimination based on SSAPRE framework
  - Global common sub-expression
  - Loop invariant code motion
  - Strength reduction
  - Linear function test replacement
- Induction variable elimination
- Register promotion

### *Inter-Procedural Analysis*

- Operates across multiple compilation runs
- Function inlining
- Inter-procedural constant propagation
  - Parameters and global variables
  - Function cloning
- Dead function elimination
- Dead variable elimination
- Automatic common block padding ■



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Lahey's **Fortran SOURCE** newsletter—  
Your source for the latest news from Lahey.

### Lahey Product Information

Comprehensive information on all products is available at [www.lahey.com](http://www.lahey.com).

#### Language Systems

- LF Fortran Enterprise v7.1 US\$1,095
- LF Fortran Enterprise + MATFOR Call
- LF Fortran Professional v7.1 US\$795
- LF Fortran Professional v7.1 + MATFOR Call
- LF **Express** v7.1 US\$249
- LF Fortran Academic v7.1 US\$75
- LF95 Linux PRO v6.2 US\$695
- LF95 Linux **Express** v6.2 US\$249
- PathScale Linux EKOPath Compiler Suite US\$1,420
- PathScale Linux EKOPath Fortran US\$1,040
- PathScale Linux EKOPath C/C++ US\$565

#### Classic Language Systems

- LF95 Windows PRO v5.7 US\$795
- LF90 v4.5 US\$895
- Essential LF90 v4.0 US\$195

#### Productivity Tools

- Winteracter US\$795
- GINO US\$900
- GINOMENU US\$600
- GINOMENU Studio Add-on US\$600
- GINO Bundle US\$2,100
- GINOMENU Bundle US\$900
- GINO Super Bundle US\$2,995
- CALGINO US\$300
- GINO .NET US\$600
- GINO .NET Bundle US\$995
- MATFOR US\$2,000
- f90SQL US\$249
- f90VB US\$299
- plusFORT Full Kit US\$995
- plusFORT Starter Kit US\$595
- Essential Fortran 90 & 95 Text Book US\$45

#### Updates/Upgrades

- LF Fortran Enterprise v7.1 Update from LF Enterprise v7.0 US\$195
- LF Fortran Professional v7.0 and LF Developer v7.0 US\$495
- LF Fortran Enterprise v7.1 Competitive Upgrade US\$895
- LF Fortran Professional v7.1 Update from LF Professional v7.0 US\$195
- LF Fortran Professional v7.1 Competitive Upgrade US\$695
- LF **Express** v7.1 Update from LF95 **Express** v5.x US\$149
- LF95 Linux PRO v6.2 Update from LF95 Linux PRO v6.1 US\$195
- LF95 Linux **Express** v6.1 US\$595
- LF95 Linux **Express** v6.2 Update from LF95 Linux **Express** v6.1 US\$149
- Essential LF90 v4.0 Update from any previous version of Essential LF90 US\$59

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