Parallel Program Analysis Framework for the ACTS Toolkit

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Parallel Program Analysis Framework for the ACTS Toolkit

- ❑ Parallel performance analysis
- ❑ Program code analysis
- ❑ Analysis tool interoperation framework
- ❑ Runtime tool interaction framework

Parallel Performance Analysis

- Tuning and Analysis Utilities (TAU)
- Program Database Toolkit (PDT)
- TAU Monitoring Framework
- Interoperation and Linking Architecture (INTERLACE)

Our Approach

- designing the TAU performance monitor for a general parallel program execution model based on HPC++;
- building a sophisticated program analysis system based on state-of-the-art parsers for C, C++, and Fortran; and
- defining interoperation and interactions methods for connecting tools and programs to one another.

Accomplishments - 1998

Our goals were ...

- To develop a robust portable performance profiling capability for C, C++, and Fortran codes; and
- To integrate performance profiling throughout the ACTS toolkit.

TAU: Tuning and Analysis Utilities

Tau is...

- an extensible tool framework supporting tool interactions with the program, the user, and each other

- a graphical, program development environment with several distinct and unique, but completely integrated, tools

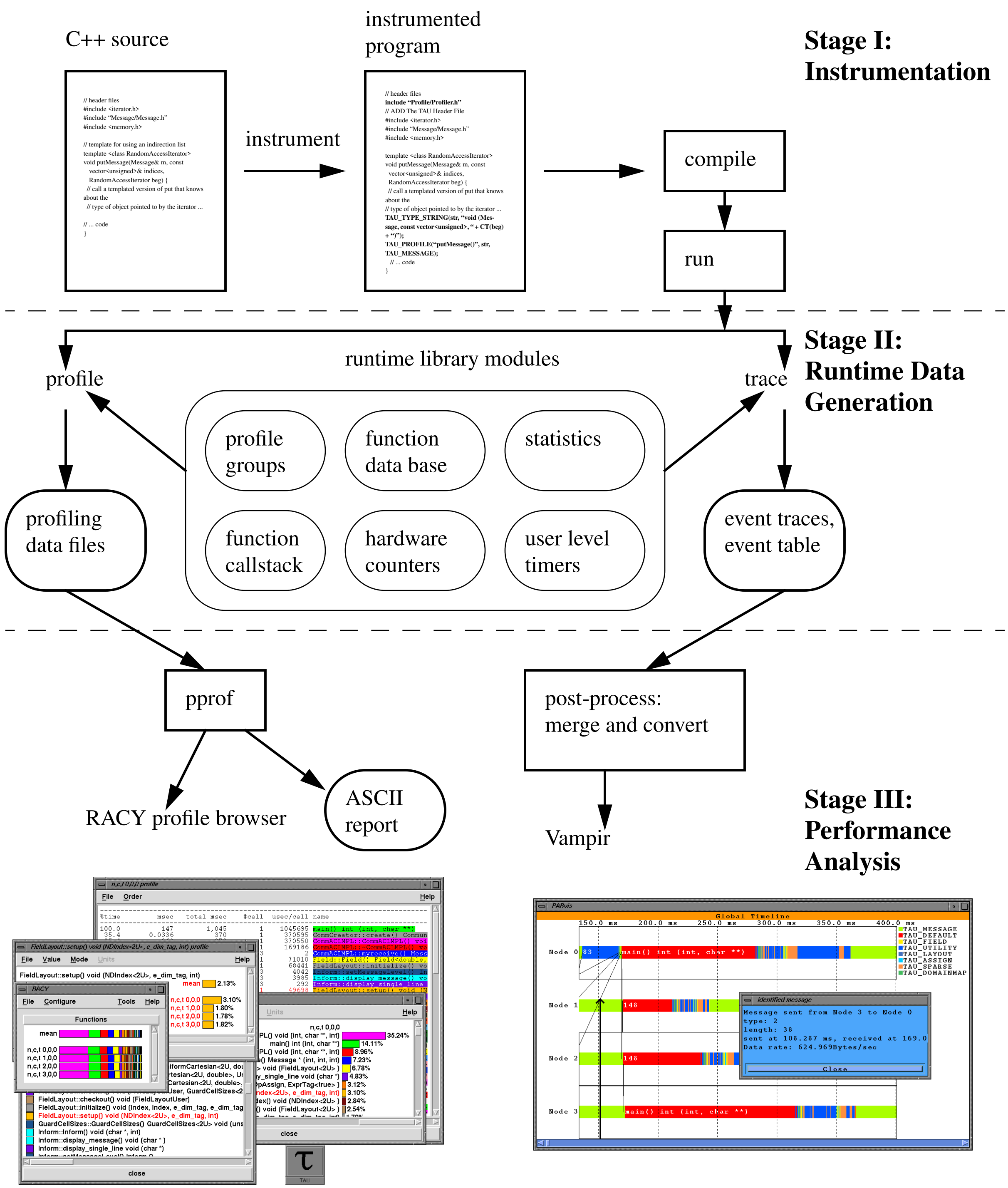
- a performance analysis environment facilitating *static* and *dynamic* interactions with programs

Tuning and Analysis Utilities

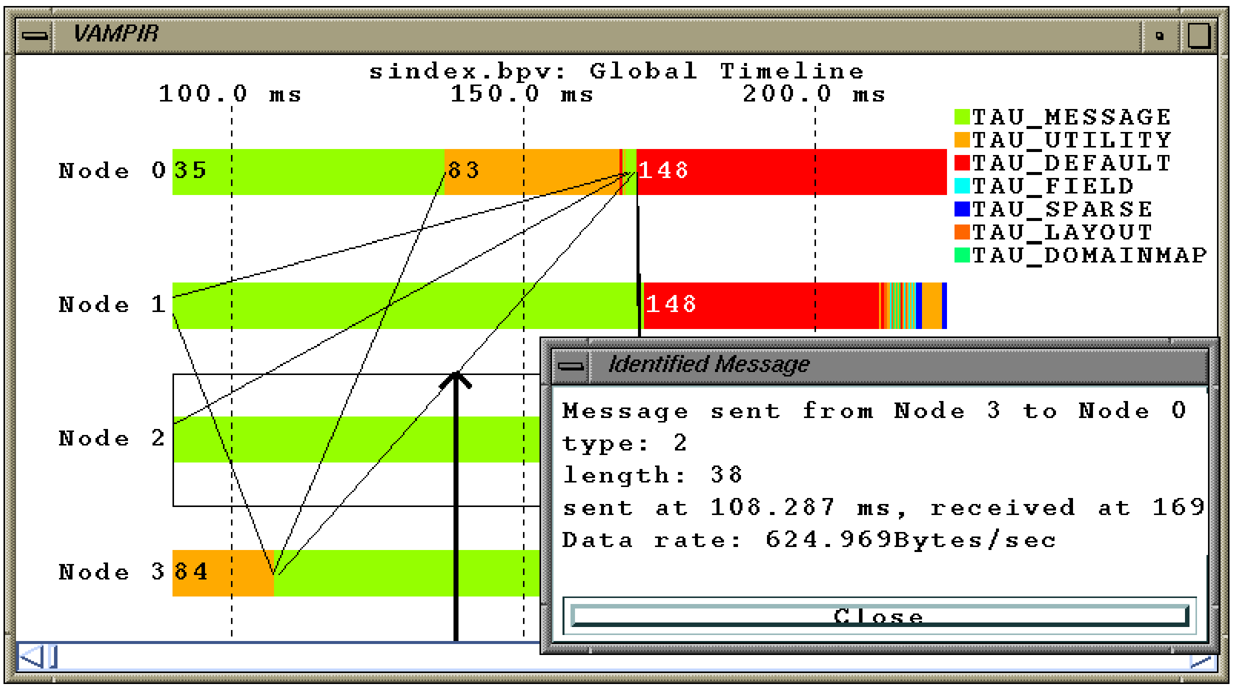
TAU Portable Profiling

- portable profiling and tracing facility for ISO/ANSI C++
  - multiple compilers, operating systems and platforms
  - templates
  - user-defined and statement level timers
  - pthreads, Tulip, and SMARTS Threads supported
- modular and configurable profiling infrastructure
- selective profiling - limit overhead to groups of profiled functions selected at runtime
- lightweight profiling facility, minimal intrusion
- timing-based instrumentation (not sampling) and support for hardware performance counters
- profiling in the presence of optimizations
- high level view of performance data

TAU Portable Profiling and Tracing

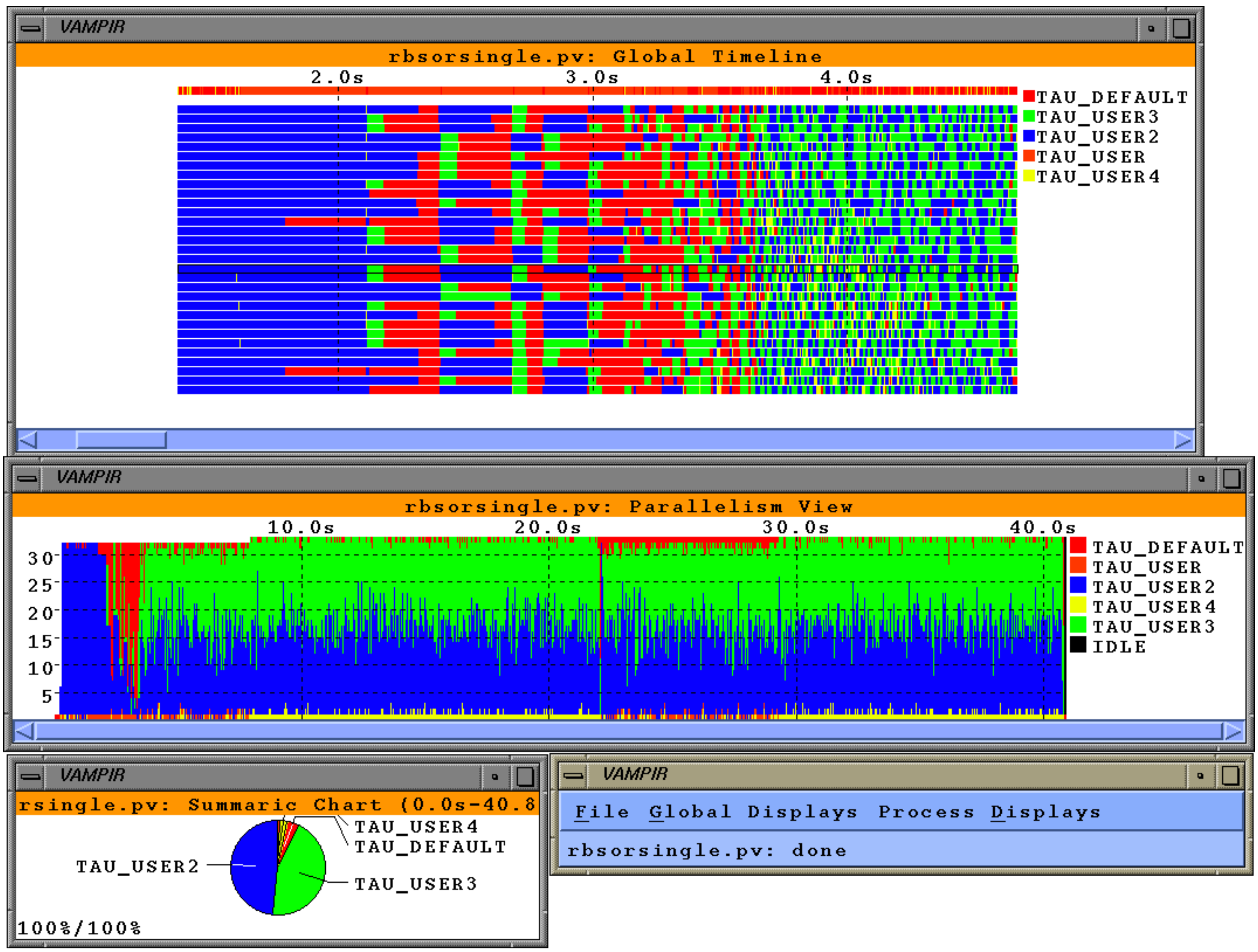


Tracing POOMA Applications



Vampir is from Pallas GmbH & KFA Germany

Tracing SMARTS (Shared Memory Asynchronous Runtime System)



PDT: Program Database Toolkit

The Program Database Toolkit was developed to:

- analyze application source code components
- make this compile-time knowledge available in a uniform way to other tools

Application of PDT

- documentation of program components can be automatically kept accurate and up-to-date
- insertion of instrumentation for performance profiling and tracing can be automated to simplify tuning and result in fewer mistakes
- automated access to interface details when calling library routines can ease programming and eliminate errors
- integration of multi-language programs can be automated, ensuring proper handling for the forms of arguments and return values

PDT Processing Steps

Edison Design Group (EDG) Front End:

- ❑ parses a C++ source file
- ❑ creates an intermediate-language (IL) tree

IL Analyzer:

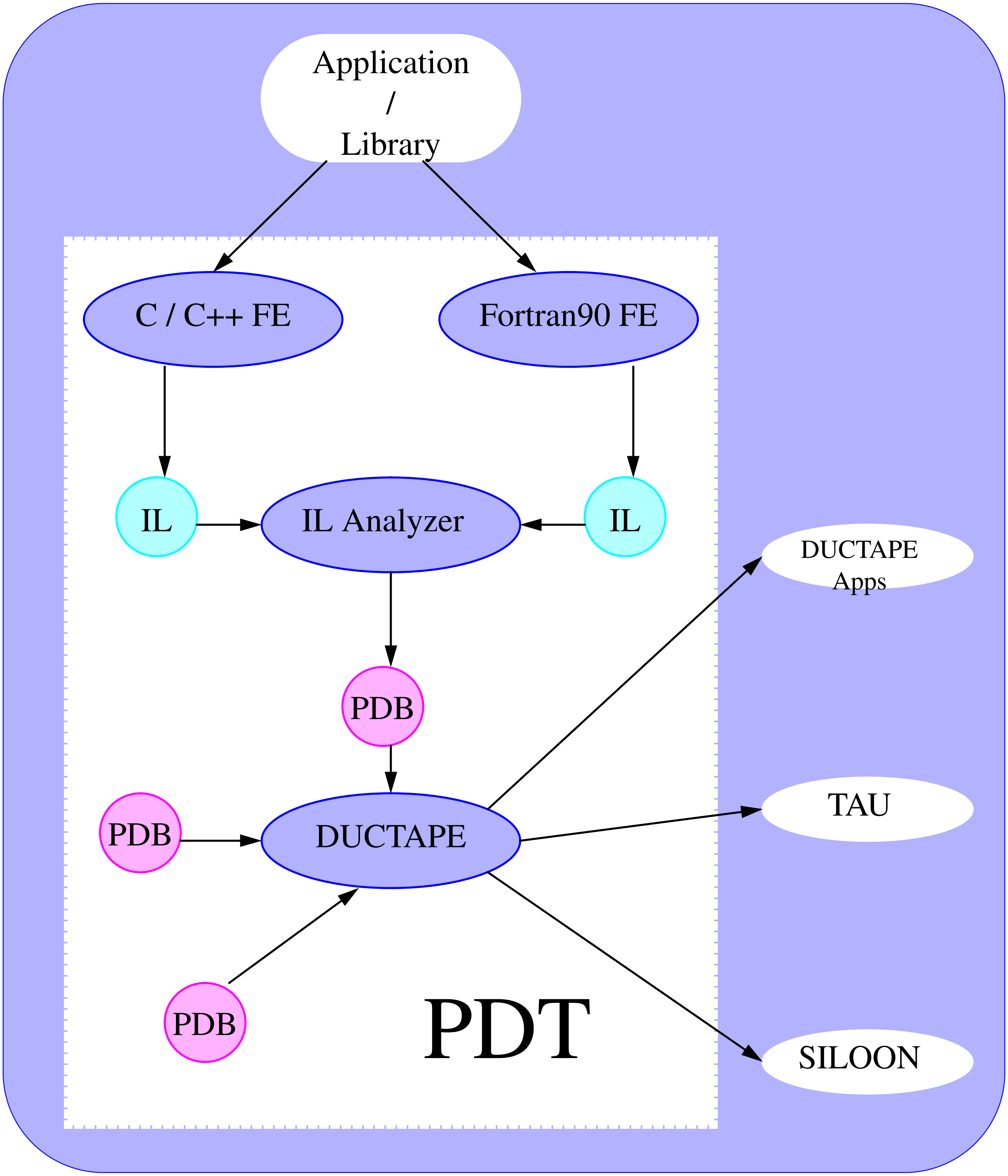
- ❑ processes the intermediate language tree
- ❑ creates another file in "program database" (PDB)

- ❑ format, that can be easily and efficiently read by a programming or a scripting language

DUCTAPE (C++ program Database Utilities and Conversion Tools APplication Environment):

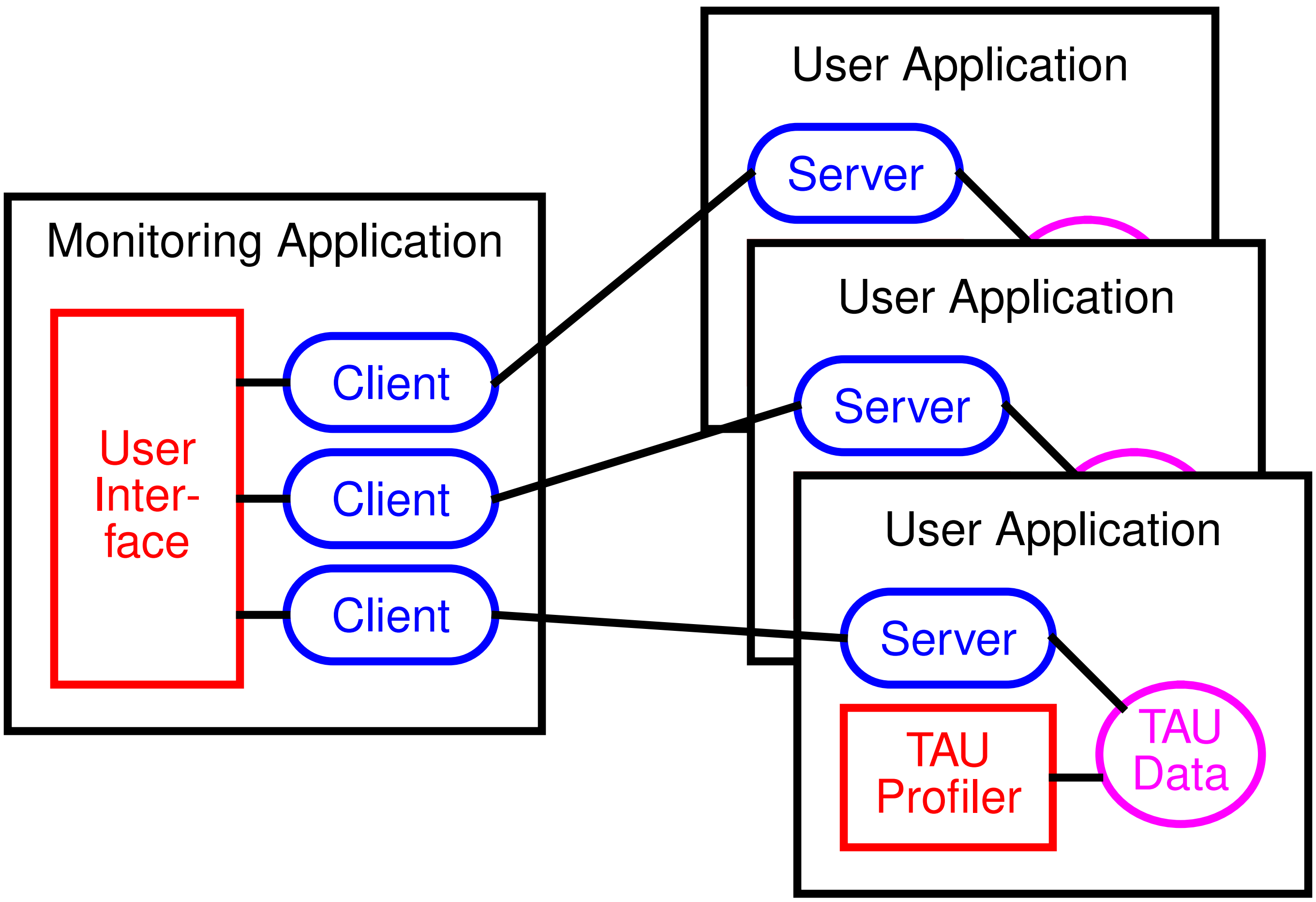
- ❑ processes and merges PDB files
- ❑ is a C++ library that provides access to the "program database" for applications

Program Database Toolkit

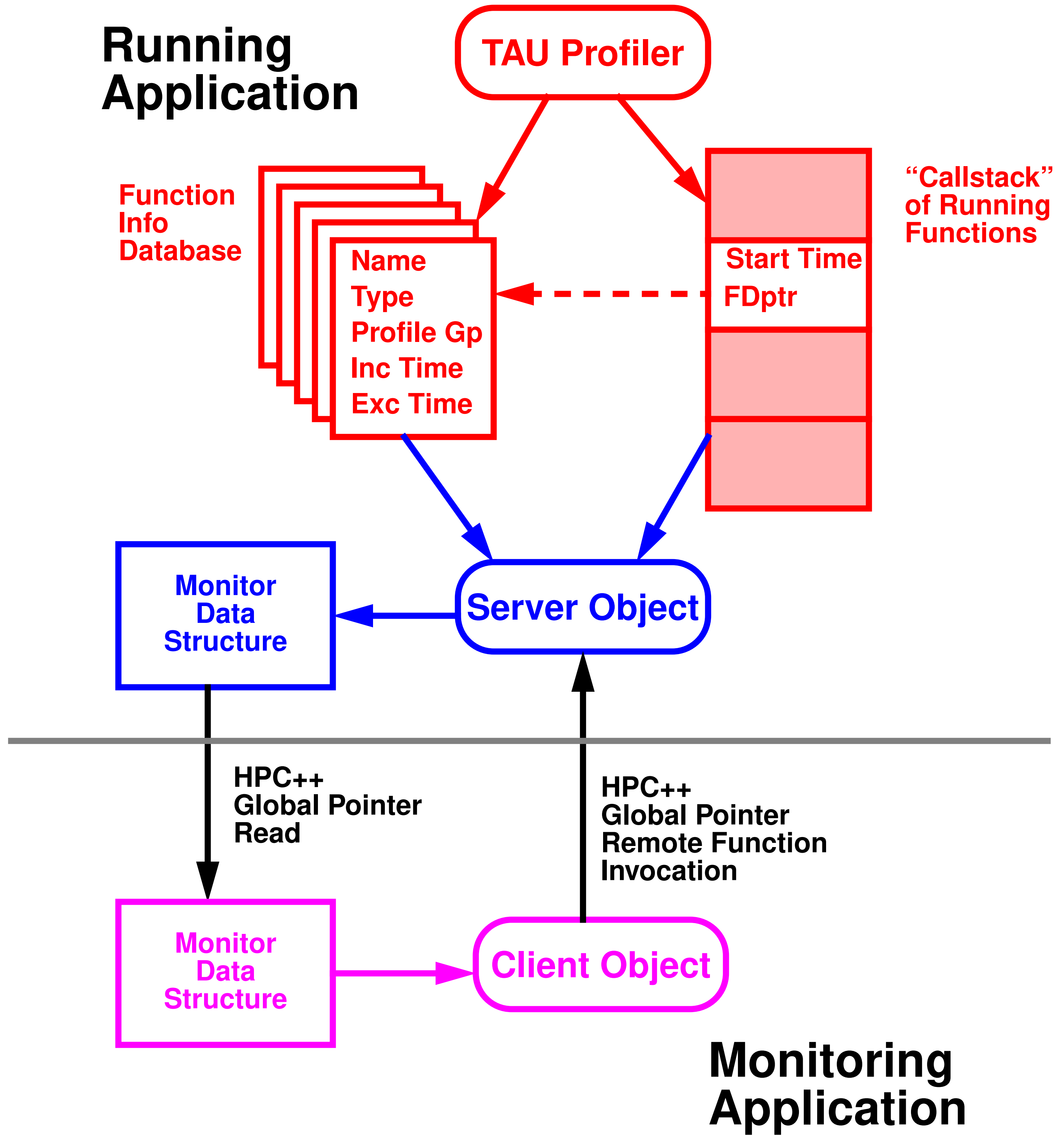


TAU Monitoring Framework

- An object-oriented framework for accessing TAU profiling data from a running application.
- Client-server architecture based on HPC++.
- All aspects of communication encapsulated in objects and hidden from user.



TAU Monitoring Framework - Details



INTERLACE

- An INTERoperation and Linking Architecture for Computational Engines
- Provides a framework for integrating computational engines into an abstract programmable environment.
- Built using HPC++ runtime system
- Prototype computational server implemented using MatLab as a target engine
- Runs on SGI IRIX
- Uses HPC++ for data movement and remote method invocation
- Provides abstract layer for connecting servers and clients to hide platform and engine specific details

INTERLACE Future Work

- Create and implement a class library for basic computational server and wrapper tasks
- Demonstrate engine interoperability by implementing IDL and Mathematica based INTERLACE servers
- Implement extended registry service for dynamic server allocation by clients
- Port current implementation to Linux-based cluster environment
- Examine methods for controlling programming servers, such as GUI based or scripting language based methods

Tool Availability

- http://www.acl.lanl.gov/tau
- http://www.acl.lanl.gov/software
  (ACL Fall 1998 CD-ROM)