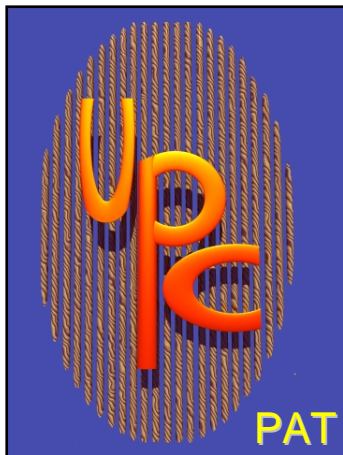




UPC Performance Analysis Tool: Status and Plans



Professor Alan D. George, Principal Investigator
Mr. Hung-Hsun Su, Sr. Research Assistant
Mr. Adam Leko, Sr. Research Assistant
Mr. Bryan Golden, Research Assistant
Mr. Hans Sherburne, Research Assistant

HCS Research Laboratory
University of Florida

Outline

- Accomplishments
- PAT High-level Design
- PAT Development Plan
- Q&A

Accomplishments

- Survey of PAT technology
- Evaluation of existing parallel PAT using a standardized scoring system
- Study of UPC language with respect to performance analysis
- Usability study
- Identification of reusable components
- Requirements for PAT
- High-level design for PAT

Performance Analysis Technologies

- Three general performance analysis approaches
 - Analytical modeling
 - Mostly predictive methods
 - Could also be used in conjunction with experimental performance measurement
 - Pros: easy to use, fast, can be done without running the program
 - Cons: usually not very accurate
 - Simulation
 - Pros: allow performance estimation of program with various system architectures
 - Cons: slow, not generally applicable for regular UPC/SHMEM users
 - **Experimental performance measurement**
 - Strategy used by most modern PATs
 - Uses actual event measurement to perform the analysis
 - Pros: most accurate
 - Cons: can be time-consuming

Tools Study: List of Tools

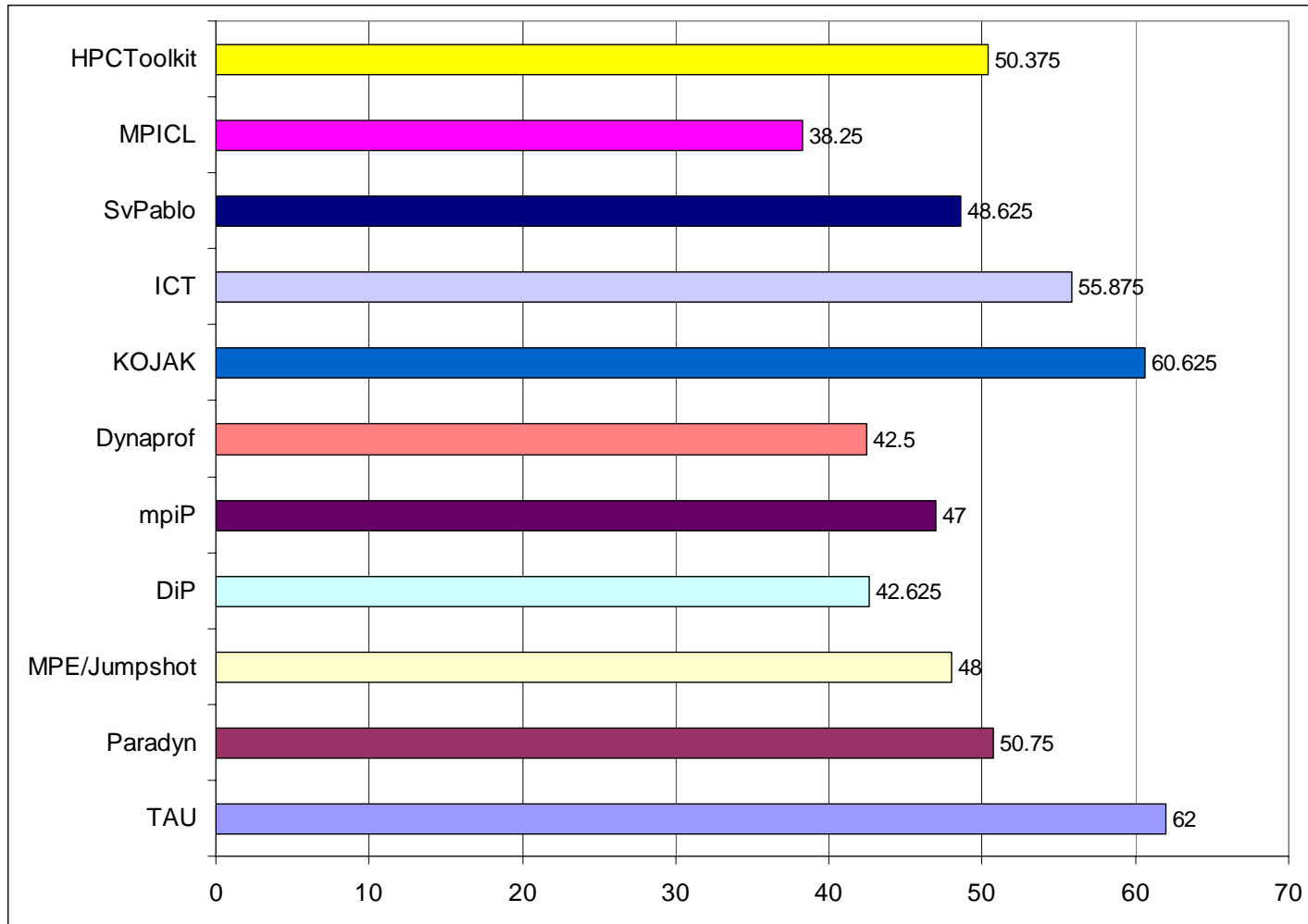
- Profiling tools
 - TAU (Univ. of Oregon)
 - mpiP (ORNL, LLNL)
 - HPCToolkit (Rice Univ.)
 - SvPablo (Univ. of Illinois, Urbana-Champaign)
 - DynaProf (Univ. of Tennessee, Knoxville)
- Tracing tools
 - Intel Cluster Tools (Intel)
 - MPE/Jumpshot (ANL)
 - Dimemas & Paraver (European Ctr. for Parallelism of Barcelona)
 - MPICL/ParaGraph (Univ. of Illinois, Univ. of Tennessee, ORNL)
- Other tools
 - KOJAK (Forschungszentrum Jülich, ICL @ UTK)
 - Paradyn (Univ. of Wisconsin, Madison)
- Also quickly reviewed
 - CrayPat/Apprentice2 (Cray)
 - DynTG (LLNL)
 - AIMS (NASA)
 - Eclipse Parallel Tools Platform (LANL)
 - Open/Speedshop (SGI)

Tools Study: Lessons Learned

- Most effective tools present data to user at many levels
 - Profile and summary data that gives top-level view of program's execution
 - Trace data that shows exact behavior and communication patterns
 - Hardware counters that show how well program runs on current architecture
- Common problems experienced
 - Difficult installations
 - Poor documentation, no “quickstart” guide
 - Too much user overhead
 - Not enough data available from tools to troubleshoot performance problems
 - Difficult to navigate tool to get to performance data or nonstandard user interfaces
 - Inability to relate data back to source code



Overall Scores



Language Study & Usability Study

- Language study
 - Hybrid pre-processor/wrapper library approach appears appropriate
 - UPC functions → wrappers
 - Others (direct memory access, upc_forall, etc.) → pre-processor
 - UPC profiling interface
 - Avoid prevention of compiler optimization
 - Obtain low-level / implementation specific data

- Usability study
 - Elicit user feedback through a Performance Tool Usability Survey – limited success thus far
 - <http://www.hcs.ufl.edu/prj/upcgroup/survey.html>
 - Review and develop a concise summary of literature regarding usability for parallel performance tools

Extensibility & Code Reuse



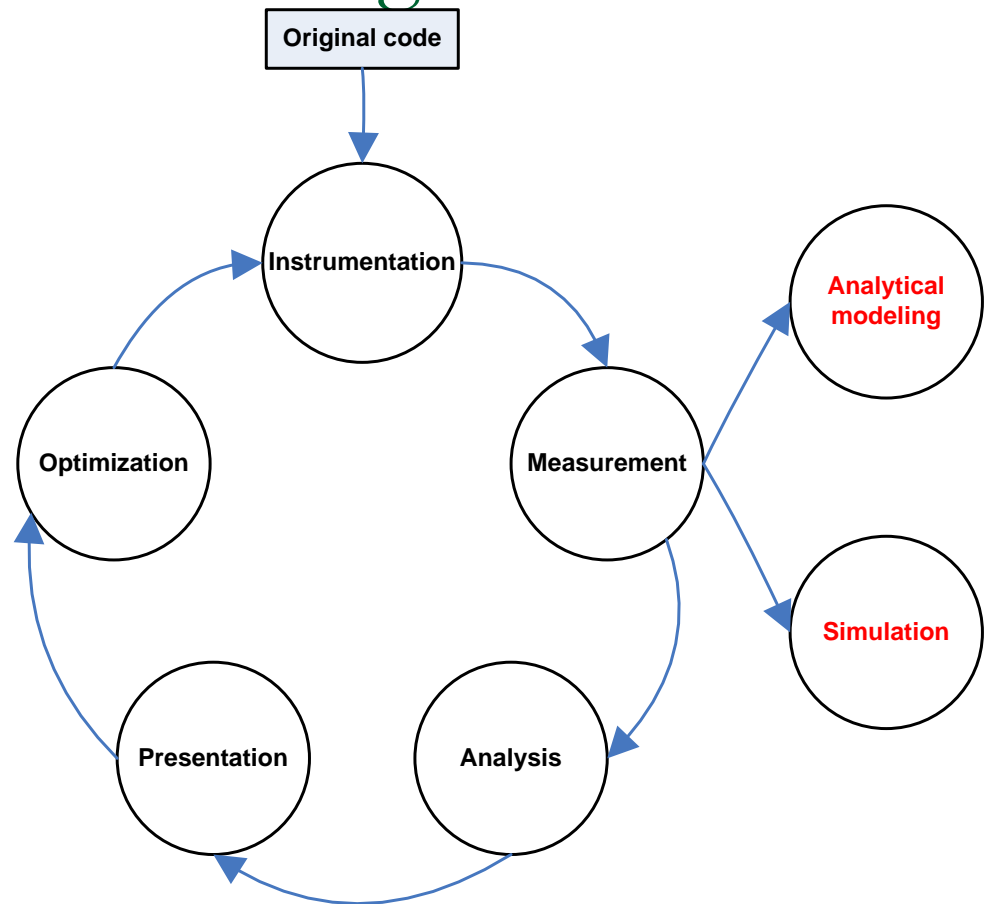
- Instrumentation & measurement units
 - Source instrumentation: tau_instrument, PDToolkit
 - Binary instrumentation: DynInst, DPCL, ATOM, Pin
 - Hardware counters: PAPI, PCL
 - General trace and profile routines: TAU, EPILOG & EARL from KOJAK
 - Use PAPI, develop own instrumentation technique (UPC profiling interface)
- Analysis unit
 - Source code correlation from wrapper libraries: HPCToolkit, mpiP
 - Pattern matching for bottleneck identification: EXPERT from KOJAK
 - Borrow idea + develop one-sided communication model
- Presentation unit
 - Trace visualization: Jumpshot, Intel Trace Analyzer or VampirNG using libvtf
 - Profile visualization: CUBE from KOJAK, Paraprof from TAU
 - Source code viewer: ToolGear, HPCToolkit
 - Develop on our own but borrow small pieces of code
- **UPC PAT → Develop new tool that borrows ideas from existing tools**

PAT High-level Design

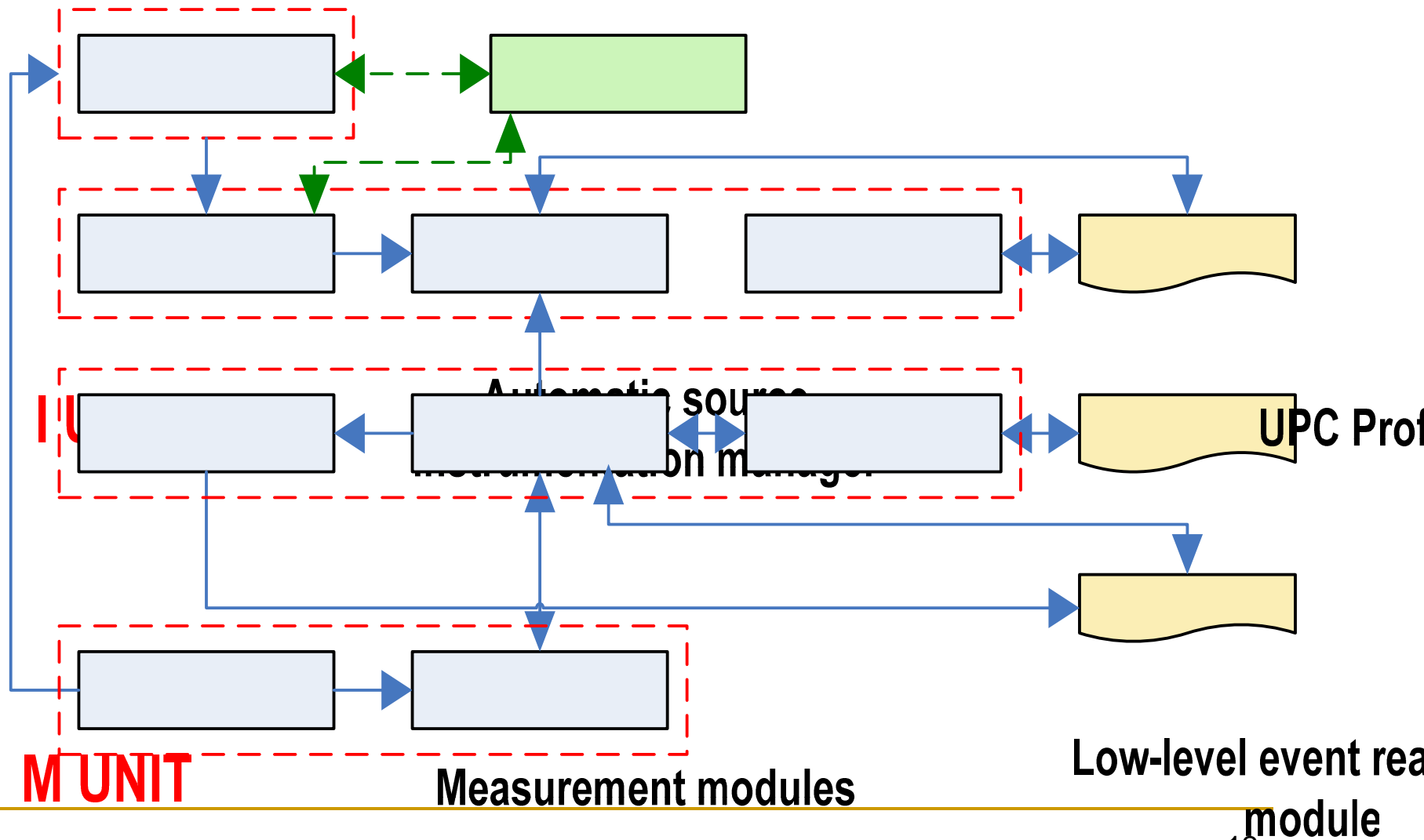
- Semi-automatic source-level instrumentation as default
 - Minimize user workload
 - Reduce development complexity
 - Provide easy source-code correlation
- Tracing mode as default with profiling support
- Analyses: load balancing, scalability, memory system
- Visualizations:
 - Timeline display
 - Speedup chart
 - Call-tree graph
 - Communication volume graph
 - Memory access graph
 - Profiling table

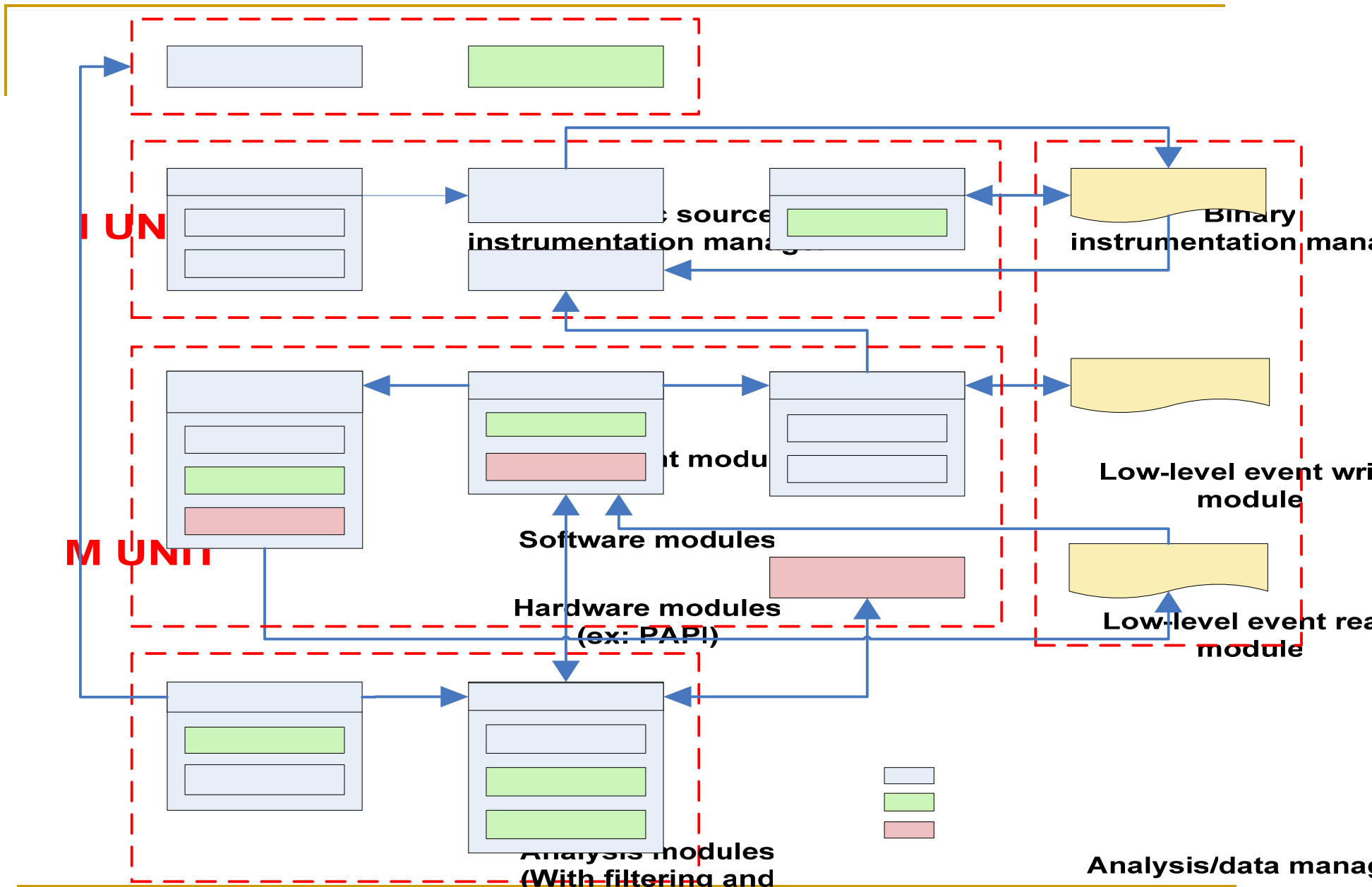
PAT High-level Design: Experimental Performance Measurement Stages

- Instrumentation – user-assisted or automatic insertion of instrumentation code
- Measurement – actual measuring stage
- Analysis – filtering, aggregation, analysis of data gathered
- Presentation – display of analyzed data to user, deals directly with user
- Optimization – process of finding and resolving bottlenecks



PAT High-Level Design – Simplified Version





21 Sep 2005

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High-performance Computer & Simulation Research Lab

Standard analysis modules

Advanced analysis

13

Search module

Performance data manager

A UNIT

M UNIT

I UNIT

Research and Release Schedule

- **Beta-tester needed!!**

PAT Release	Delivery Date
I and M modules for 1st platforms	April 1, 2006 (Month 6)
I, M, and A modules for 1st platforms	July 1, 2006 (Month 9)
I and M modules for 2nd platforms	July 1, 2006 (Month 9)
Beta-1 (I, M, A, and P modules for all platforms)	October 1, 2006 (Month 12)
Beta-2	December 1, 2006 (Month 14)
Beta-3	February 1, 2007 (Month 16)
Version 1.0	April 1, 2007 (Month 18)

Q & A

