



# Eclipse-Based Tools for UPC

## Toward Improved Productivity via Integrated Toolsets



### Introduction: Productivity and Tools in HPC

- High-performance computing (HPC) has goal of achieving high levels of application performance
  - Programmers need effective tools to cope with many complexities of parallel machines and software environments
- DARPA's HPCS initiative has emphasized importance of *productivity* in HPC
- Many tools aid productivity throughout development process
  - Programming model is key; PGAS models can offer notable advantages
  - Other tools: editor, debugger, variety of static & dynamic analysis tools
  - Tools may be most effective as part of integrated development environment (IDE)



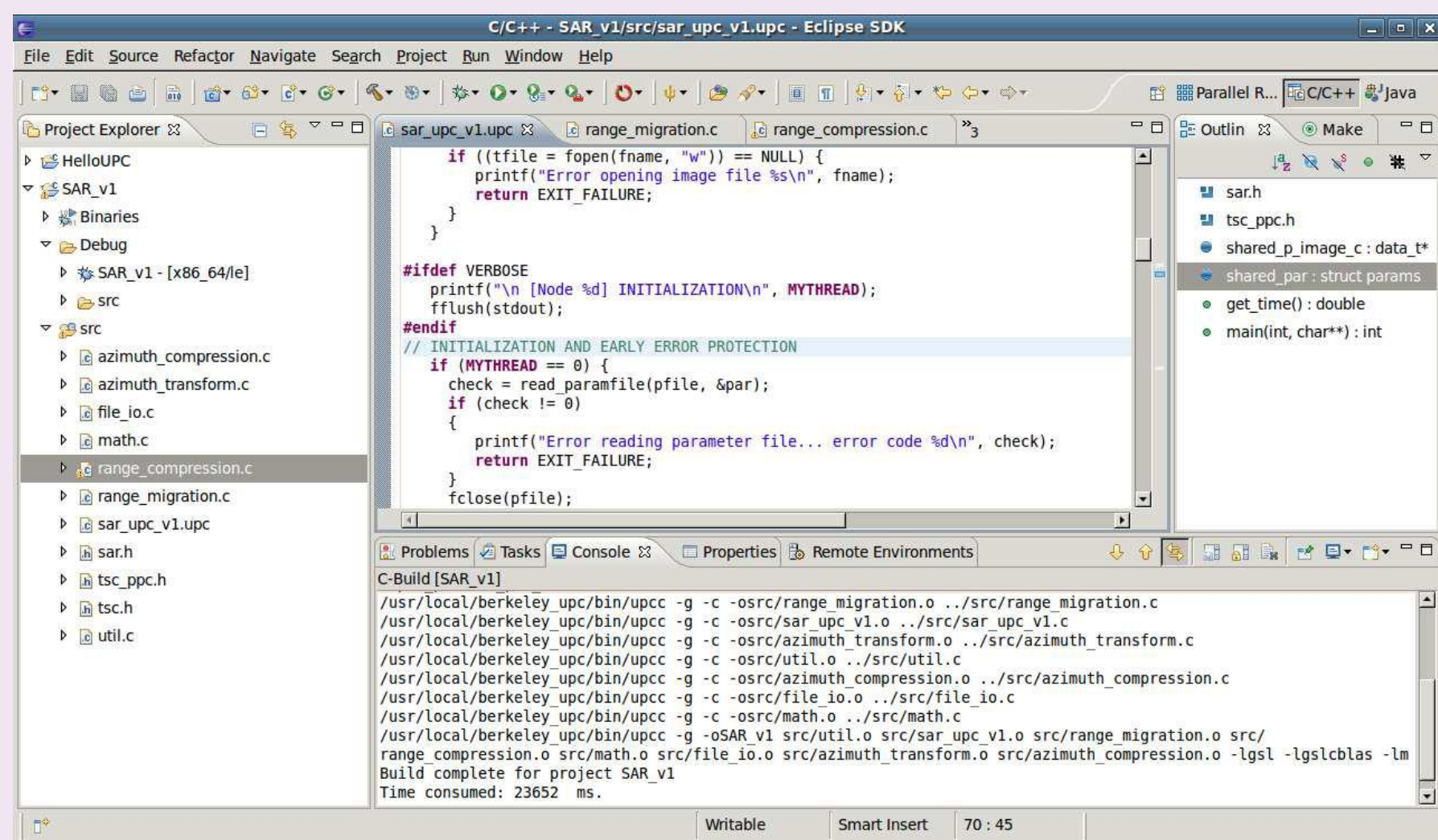
### Eclipse Platform

- Eclipse: open-source, extensible development platform
  - For users: full-featured IDE
  - For developers: platform to integrate tools via plug-ins
- C/C++ Development Tooling (CDT) project
  - Support for development using C-like languages
- Parallel Tools Platform (PTP) project
  - Integrated environment for developing *parallel* applications
- Initially focused mainly on MPI and OpenMP development tools



### UPC Tools in Eclipse

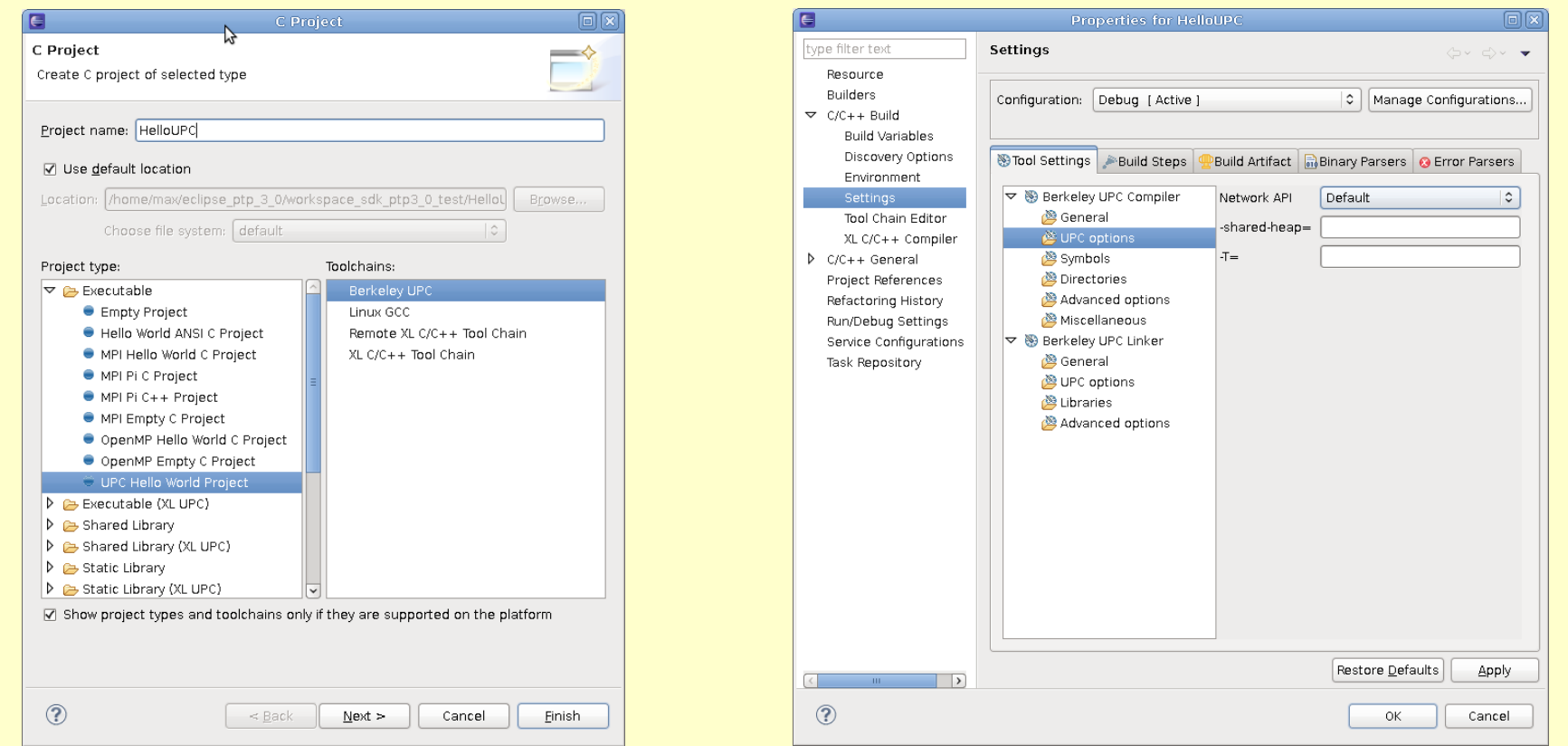
- UPC language is supported in Eclipse (via CDT project)
- Existing functionality in CDT
  - Original CDT parser was hand-coded for particular syntax of GNU C
  - Additional, more extensible parser was written by IBM; employs externally-generated grammar file for particular language variation
  - This capability was used by UPC tools to provide UPC-specific parser
  - Tool-chain for XL UPC compiler also developed by IBM



Eclipse workspace with UPC Synthetic Aperture Radar application

### Berkeley UPC Toolchain and Project Wizard

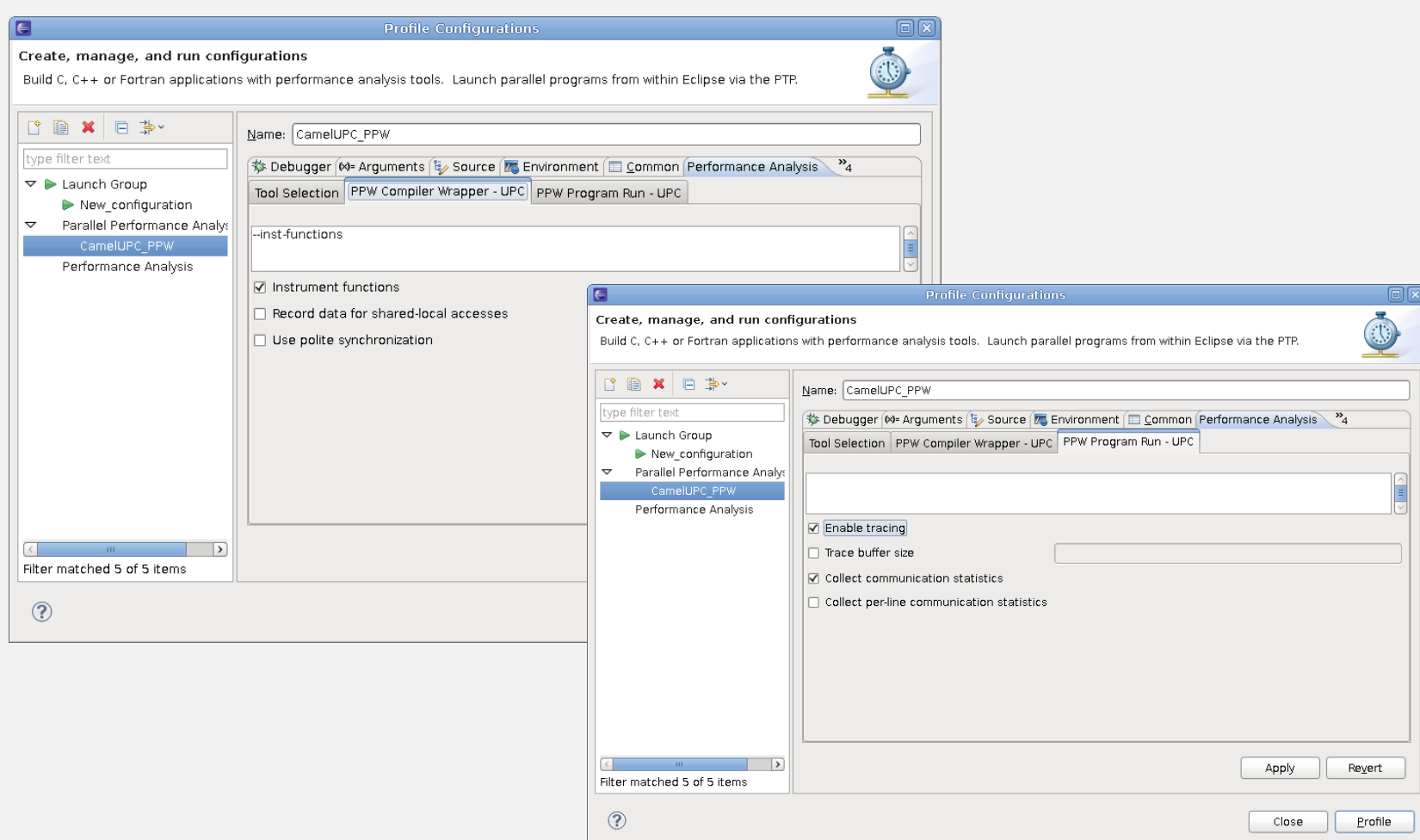
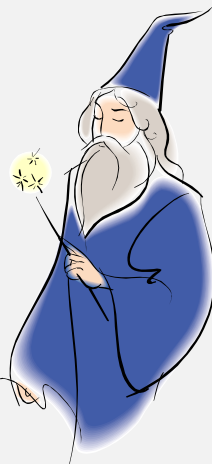
- Berkeley UPC: portable, open-source UPC compiler developed at U.C. Berkeley / LBNL
- Berkeley UPC tool chain (now part of Eclipse CDT)
  - Allows for use of Berkeley UPC for managed builds: Eclipse handles details of building application
  - Provides interface for setting Berkeley UPC compiler/linker options
- UPC project wizard
  - Simple "Hello World" project wizard provides UPC code template aimed at less experienced UPC users



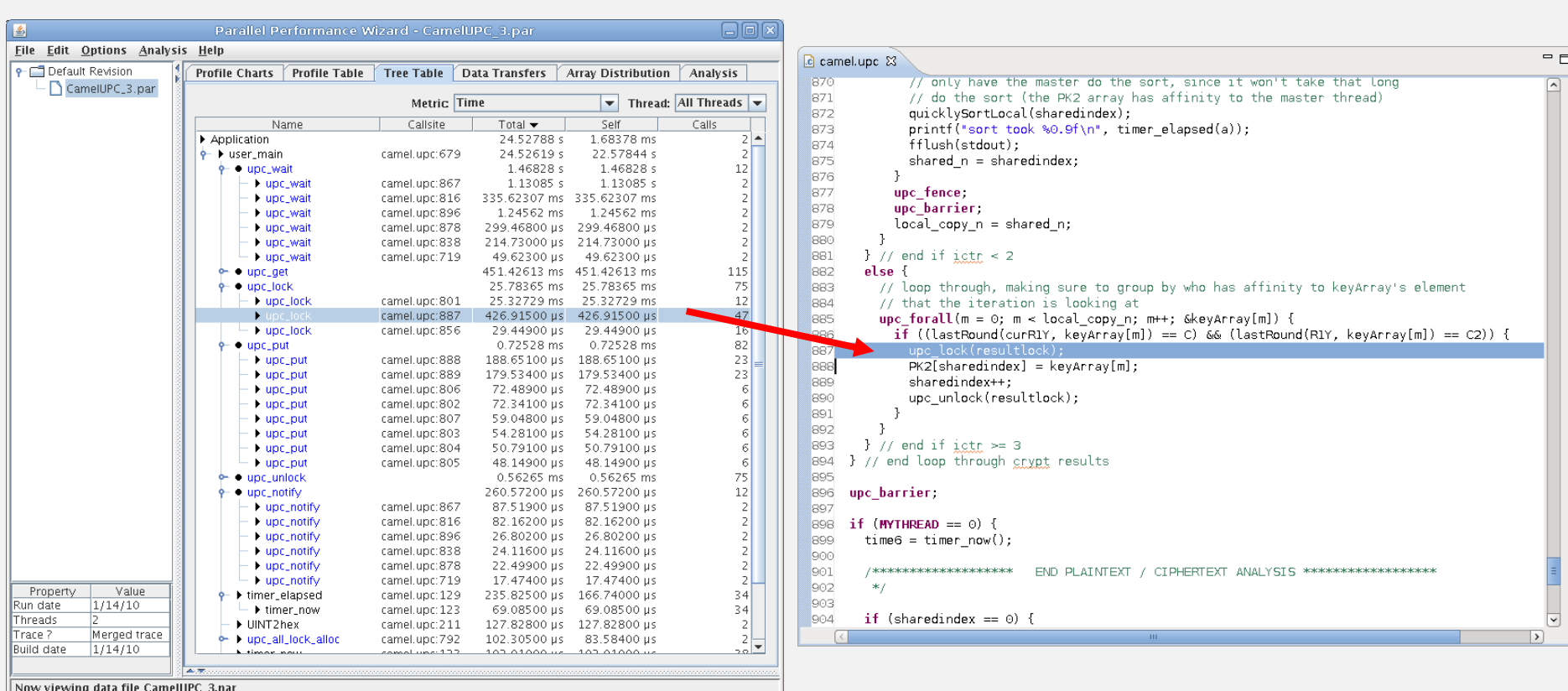
Eclipse dialogs for creating a Berkeley UPC project

### Parallel Performance Wizard (PPW) Support

- Developers often must pursue iterative performance analysis process to attain desired application performance
- Parallel Performance Wizard (PPW): performance tool specifically designed for PGAS application analysis
  - In research & development at University of Florida since 2004
  - Latest version is full-featured tool with portable "backend," GUI providing visualizations, and advanced automatic analysis
- Support for PPW in Eclipse environment:
  - Integrates with PTP's External Tools Framework (ETFw)
  - Provides access to PPW capabilities entirely within Eclipse
  - Allows PPW GUI to be directly launched from within Eclipse



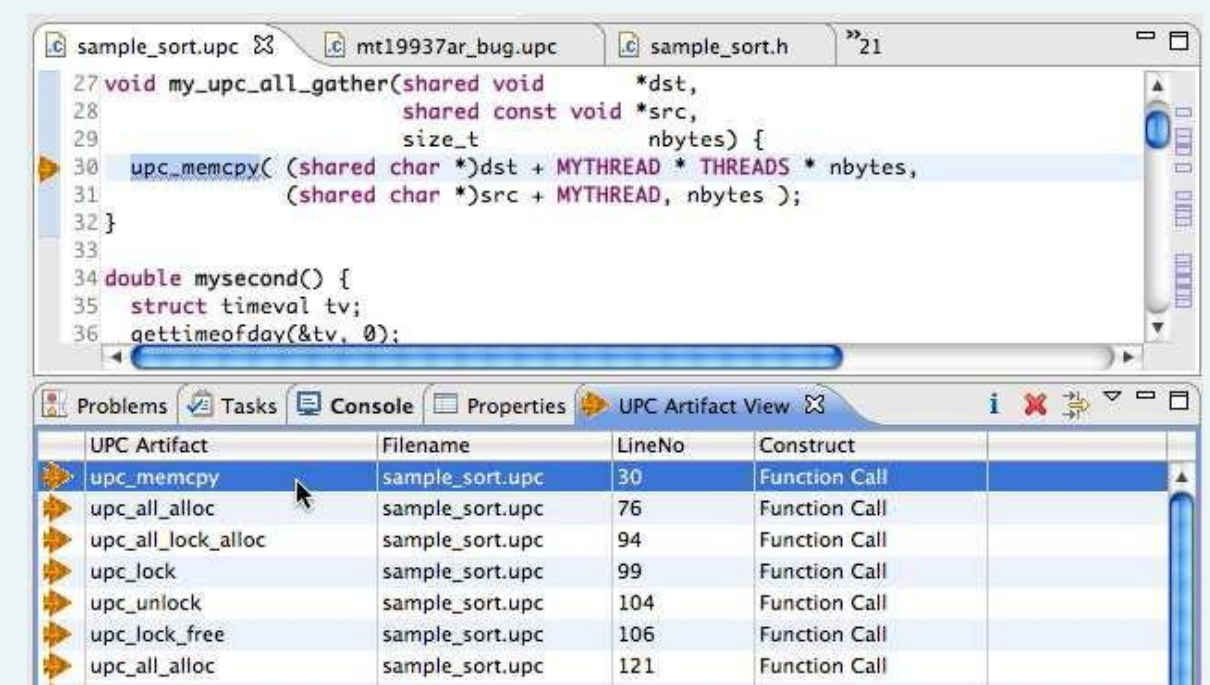
Eclipse dialogs for specifying PPW build and run options



PPW launched from Eclipse: source code correlation shown in Eclipse editor

### UPC Analysis Tools in PTP

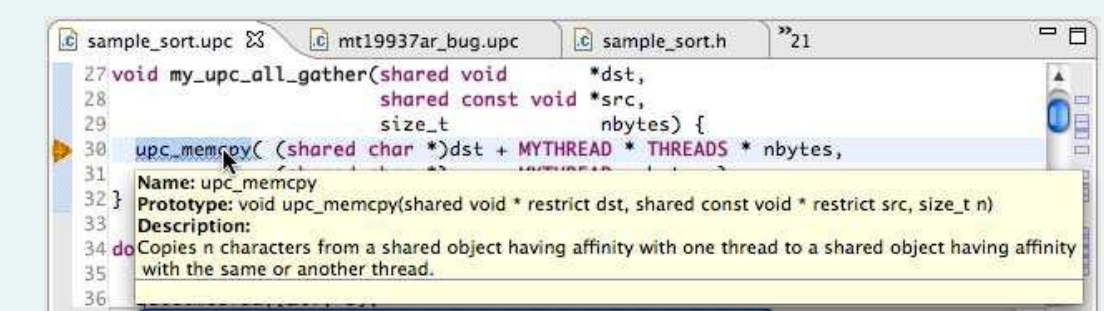
- Static analysis tools are part of Parallel Language Development Tools (PLDT) feature of PTP; use source code to help improve application
- Initial static analysis functionality for UPC
  - UPC "artifacts," such as calls to UPC library APIs, can be located
  - Separate Eclipse view shows artifacts discovered, with easy navigation to source-code lines
- Infrastructure exists for more advanced analysis tools for UPC
  - Can use CDT-provided AST and PLDT-provided control-flow graph
  - These facilities allow for analysis of complex program structures



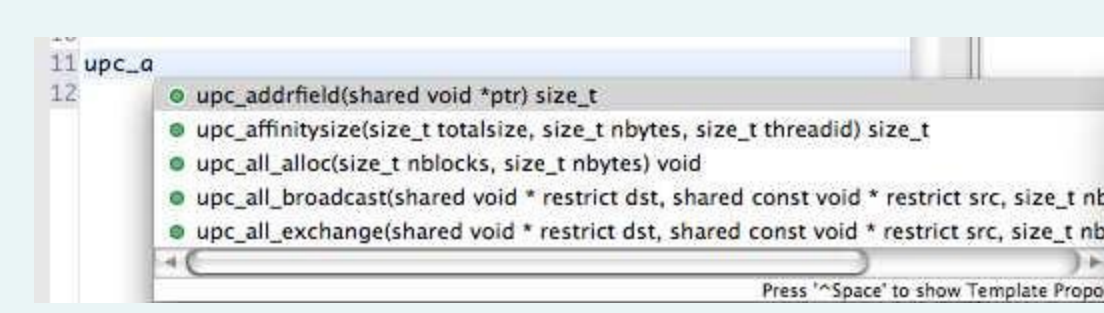
UPC artifacts are identified and linked with editor

### User Assistance Tools for UPC

- Eclipse help system
  - Hovering over UPC code in editor invokes "pop-up" feature with API information (sourced from header files + content from PTP and PLDT)
  - Separate help view also available via F1 key or menu; HTML files can be perused which provide information and examples for APIs
- Content assist
  - Dynamic assistance in Eclipse editor helps remind programmer of UPC language/library APIs and arguments
- Plus many other Eclipse features...



Hover help gives assistance for UPC constructs



Content assist inserts code into editor as you type