

A Mobile Debugger for Mobile Programs

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Mobile programs can move computation from one site to another during execution. This flexibility has many potential advantages [3]. It, however, comes at a cost. Mobile programs are hard to debug. Debugging distributed programs is hard even without mobility; adding mobility makes it harder. Our experience with implementing and using mobile languages [1, 4] indicates that suitable debugging support is critical if mobile programs are to fulfill their potential. We briefly describe the design and implementation of *Asbestos*, a debugger for mobile programs written using the AGNI framework [4].

Asbestos allows position-independent debugging of AGNI programs. It allows users to monitor and control the execution of multiple communicating mobile programs. It provides local and global single-stepping, local and global break-points, and local and global watch-points.

AGNI programs are organized around Mobile Streams [4]. A Mobile Stream (MStream) is a named communication end-point that can move from machine to machine while maintaining a well-defined ordering guarantee. Multiple message-handlers may be dynamically attached to (and detached from) an MStream and are independently and concurrently invoked for each message. Handlers operate in an atomic fashion – changes in the state of the MStream (location, set of handlers etc.) are allowed only in between messages. An MStream has a globally unique name. AGNI is implemented using Tcl. An AGNI program consists of a set of MStreams and the associated message-handlers (written in Tcl).

Asbestos is built on top of the Tcl debugger [2] and uses it for all local debugging. *Asbestos* glues together multiple debuggers to provide global debugging (global break-points, watchpoints and synchronized single-stepping). In addition, it keeps track of the state of individual debuggers. When an MStream moves, *Asbestos* detaches the local debugger(s), captures its (their) state and ships the debugger state along with the MStream data and handlers. At the

destination site, it resumes the debugging session by creating new instance(s) of the debugger, initializing its (their) state using the captured information and attaching it (them) to the message-handlers. This allows the debugging session to continue without disruption.

Asbestos implements its functionality using a pair of designated message-handlers and a channel for out-of-band (OOB) communication. One of these handlers, the *pre-handler*, is guaranteed to run as the first handler; the other, the *post-handler*, is guaranteed to run as the last handler. The OOB channel is used to communicate with the debugger as well as to interact with the program being debugged (*stdin/stdout*). It keeps track of the state of the debugger by logging all relevant user commands - such as break-points, watch-points etc. When an MStream moves, this log is compacted (to eliminate matched operations such as addition/deletion of a break-point) and shipped with the data and the message handlers associated with the MStream. The *pre-handler* and the *post-handler* are used to implement the inter-debugger synchronization needed for global debugging operations.

References

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