

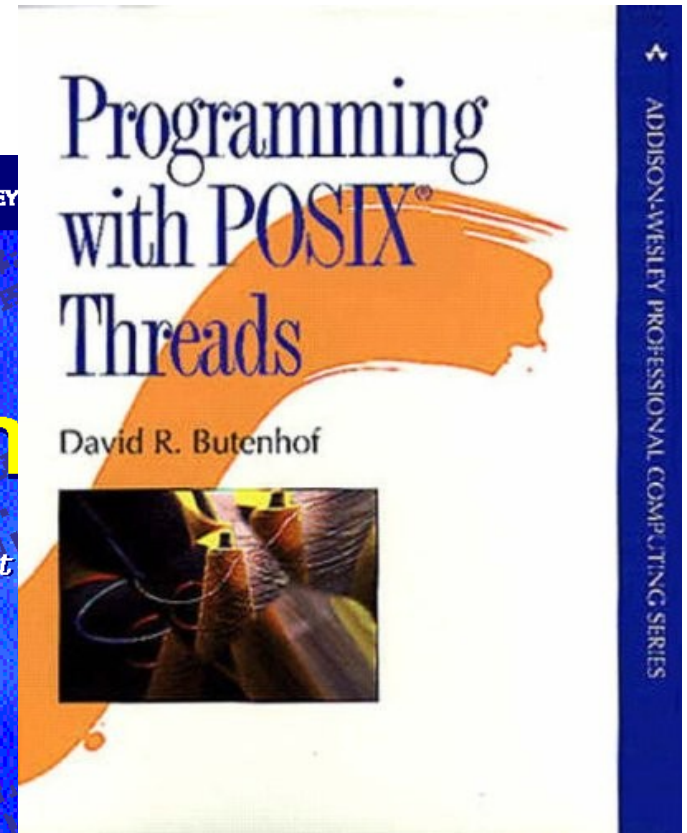
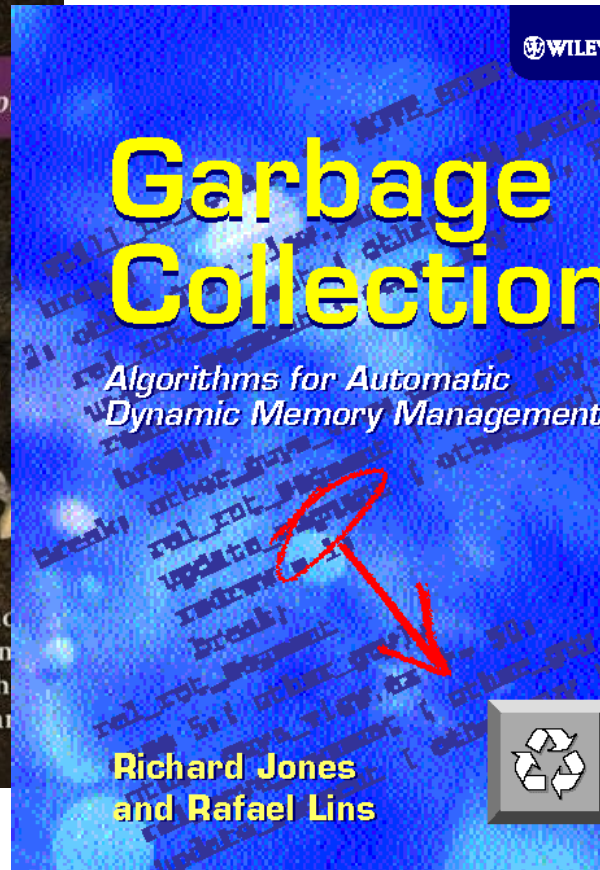
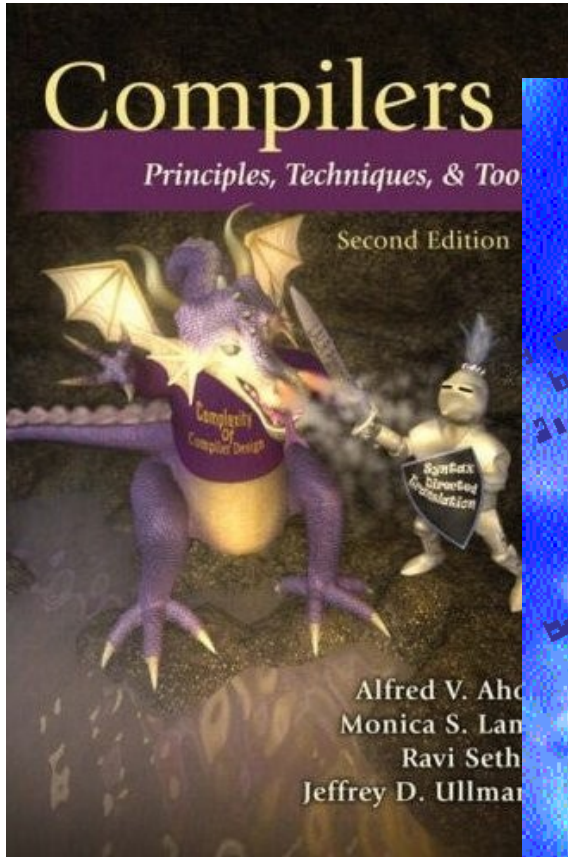


VMKit: a Substrate for Managed Runtime Environments

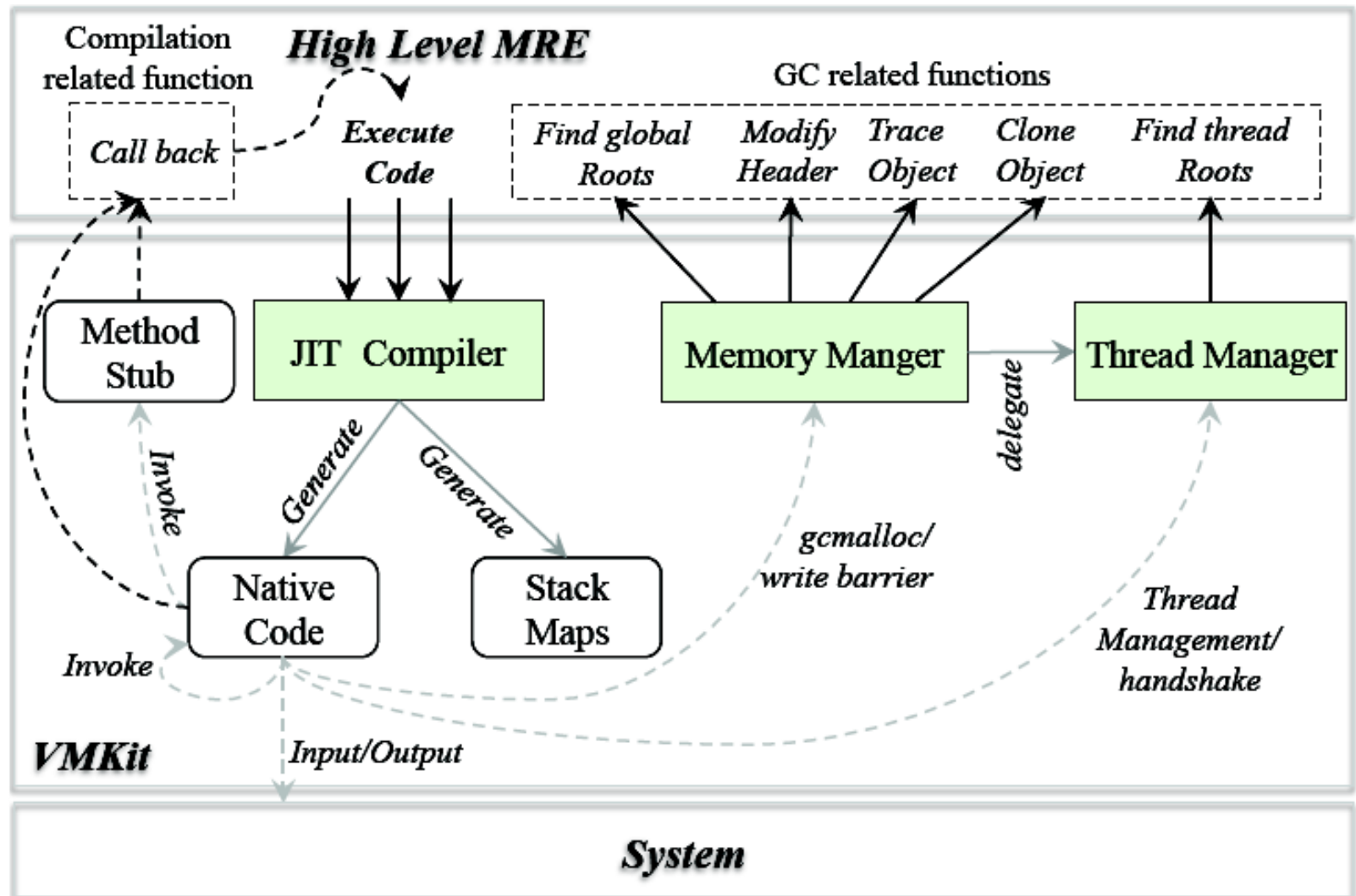
Nicolas Geoffray, Gael Tomas, Julia Lawall,
Gilles Muller, Beril Folliot

–Dresden, 2010-05-25

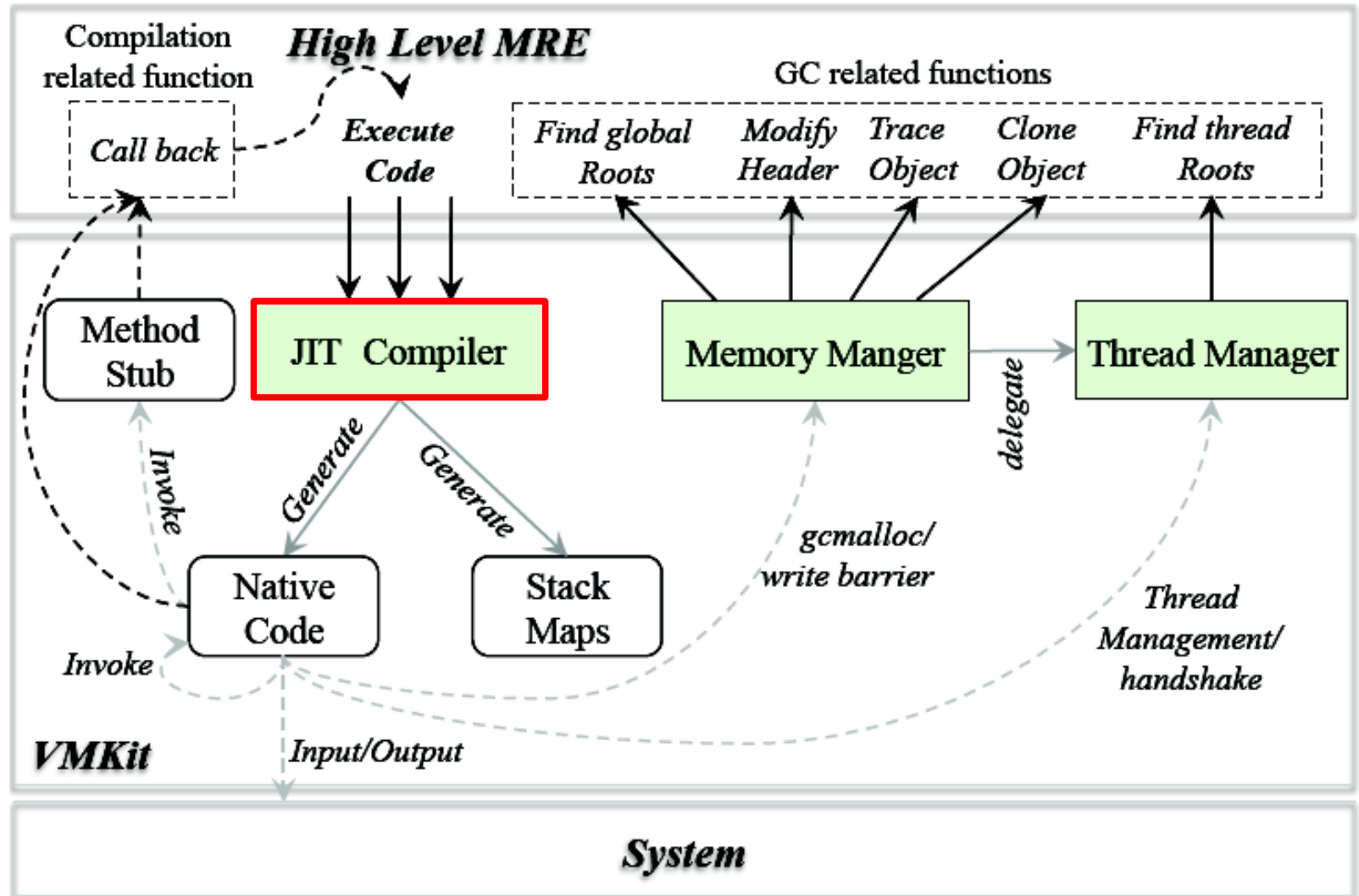
- Java, .NET
- Intermediate code representation (Java byte code / MSIL)
 - Portability
 - Language-independence
 - Safety / Security



Providing an MRE construction kit



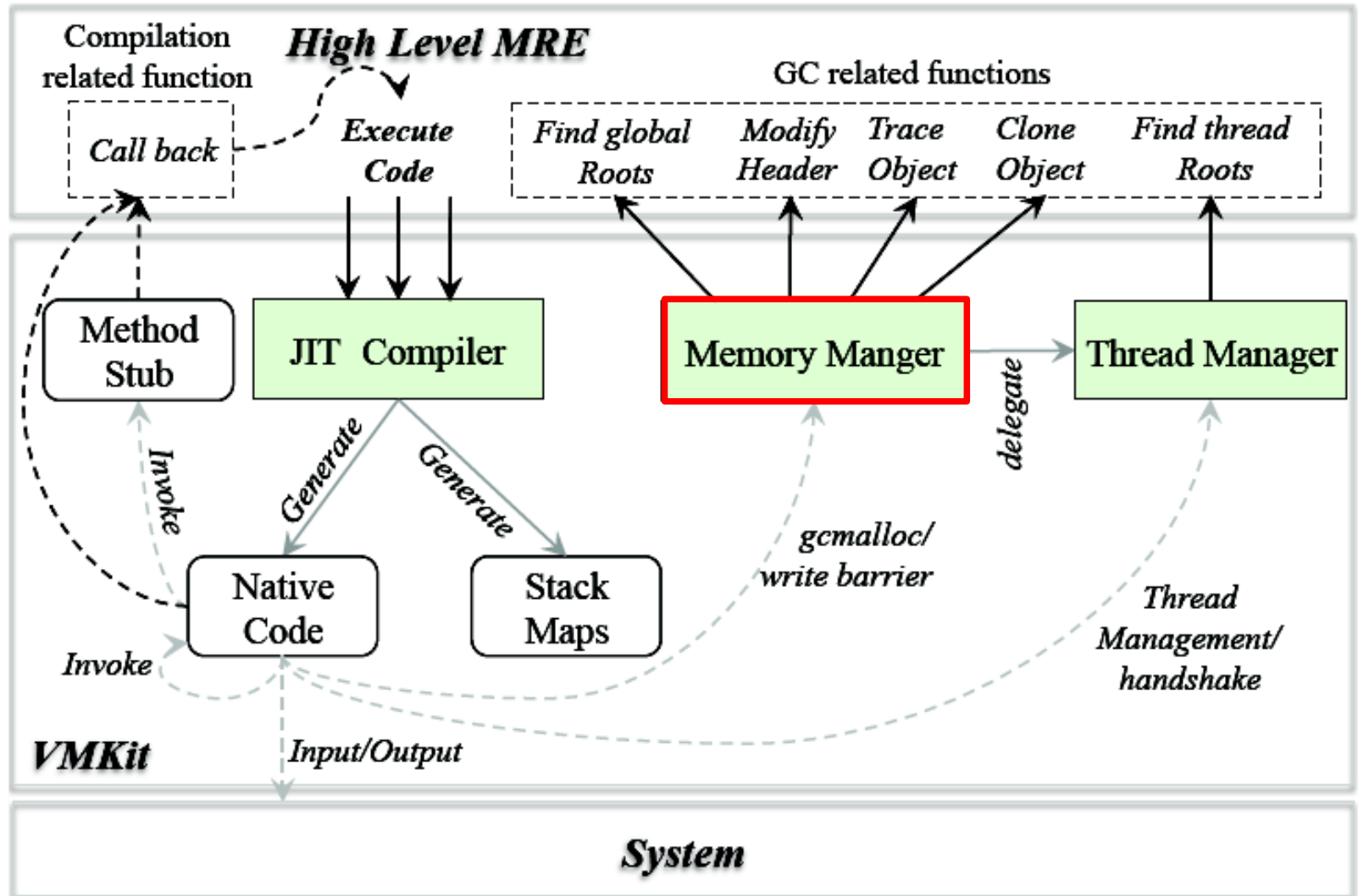
Providing an MRE construction kit



- LLVM as abstract language
 - No requirements on object model or call semantics
 - Efficient code generation
 - Ability to generate stack maps
- Instruction set
 - Stack-based (Java) vs. register based (LLVM)
- Supports lazy compilation

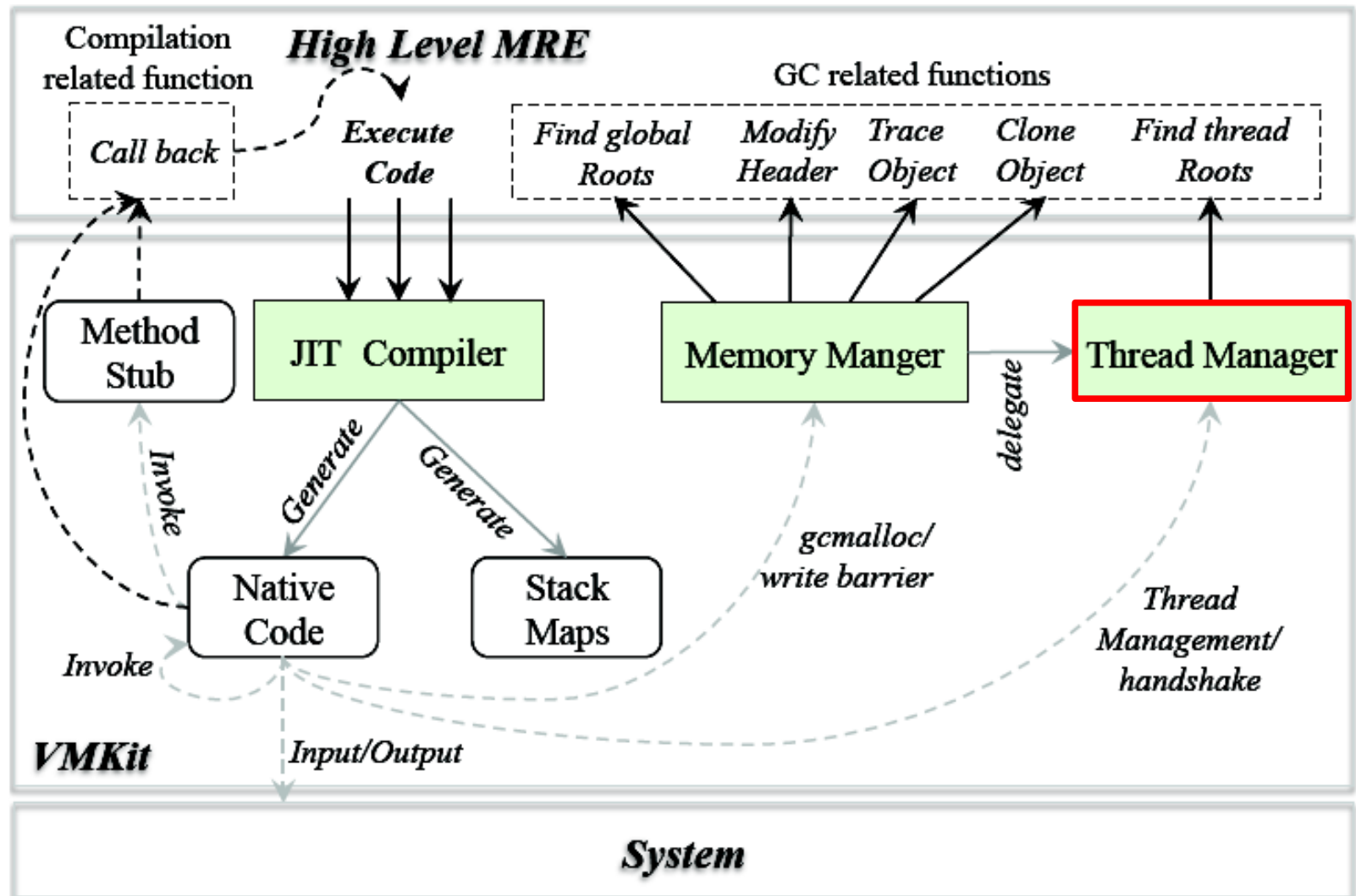
- Intrinsic := function / instruction sequence the compiler recognizes and replaces with a more efficient version
 - printf() → puts()
 - compiler-builtin functions (memcpy, strcpy, ...)
 - OpenMP
- Supported by LLVM
- Language-dependent
 - MRE must provide compilation callbacks

Providing an MRE construction kit



- State-of-the art collection of GC algorithms
- Written in Java
 - 2-phase compilation:
 - MMTk/Java → MMTk/LLVM
 - MMTk/LLVM → MMTk/native
 - Keep LLVM representation for inlining
- MRE callbacks
 - 5 functions to support GC
 - Find root objects
 - Trace object (find sub-objects)
 - Modify object header
 - Clone object

Providing an MRE construction kit





- Thread support layer
 - POSIX Threads
- Per-thread memory for multi-threaded GC
 - Located on thread's stack
 - Easily accessible
- Handshake lock to be polled by all threads

- J3 runtime
 - Interfaces with GNU Classpath libraries
 - Optimized in many cases
 - Developed in parallel to VMKit
- N3 runtime
 - Interfaces with Mono
 - Developed on top of VMKit (~ 2 months)
 - Less optimized



- Implemented a Java MRE in 20,000 LoC (Sun: 6,500,000)
- VMKit: 450,000 LoC
- Memory footprint not yet optimized
- Competitive in Java / .NET benchmarks
 - Still potential for optimization though



- Is Flash™ a managed runtime?
- L4Re (NUL) integration?