Memory Safety for Telecommunication Systems

Ericsson Research has assessed the suitability of CHERI for telecommunication systems that require high performance and fault tolerance.

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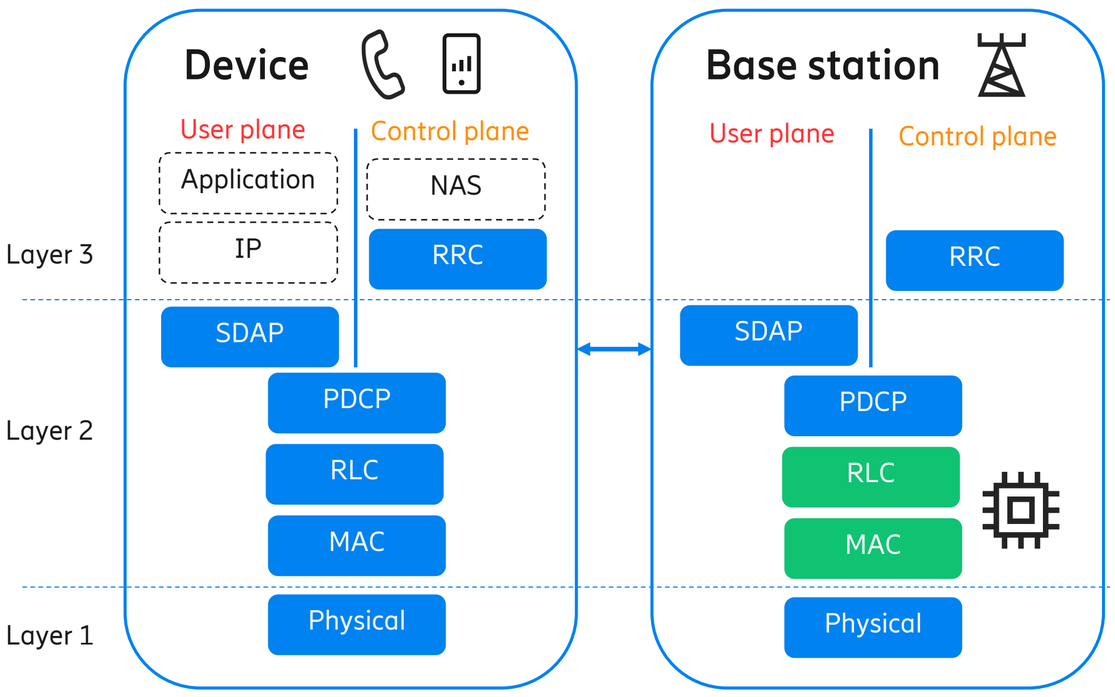
Porting effort and **performance impact** of Arm Morello on **RLC** and **MAC** benchmarks

Fredrik Hessner, Håkan Englund, Merve Gülmez, Peter Svensson



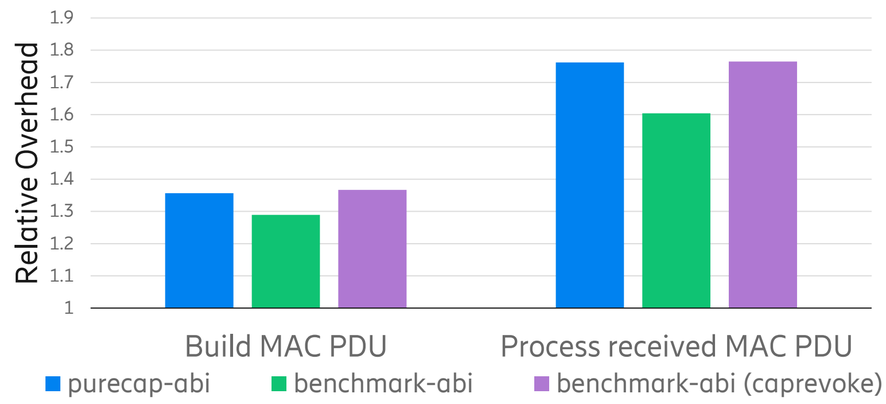
Radio Link Control (RLC) – concatenate, segment and reassemble RLC Packet Data Units (PDUs) to/from MAC/PDCP data units; reorder, duplicate detection, RLC re-establishment
Medium Access Control (MAC) – map logical and transport channels; resource allocation; scheduling and priority; error correction; multiplexing data flows

Porting effort

CHERI-related benchmark changes:
- Less than %1 LoC changes to introduce capabilities
- Includes CHERI-related changes to custom heap allocator

BSD-related changes:
- Removal of Linux Tracing Tool Next Generation (LTTNG).
- Naming differences between Linux and BSD

Performance using RLC and MAC benchmarks



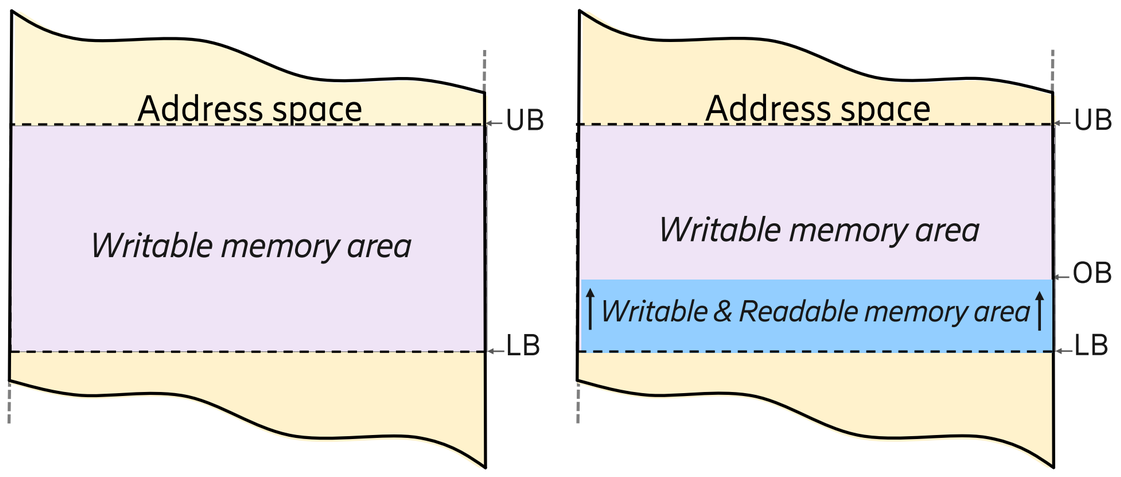
Overhead relative to non-capability baseline using hybrid mode application and kernel. All benchmarks run in purecap mode on purecap kernel. Max std = %4.9

CHERI-extension for **conditional capabilities** preventing **uninitialized memory accesses**

Merve Gülmez, Håkan Englund, Jan Tobias Mühlberg, Thomas Nyman

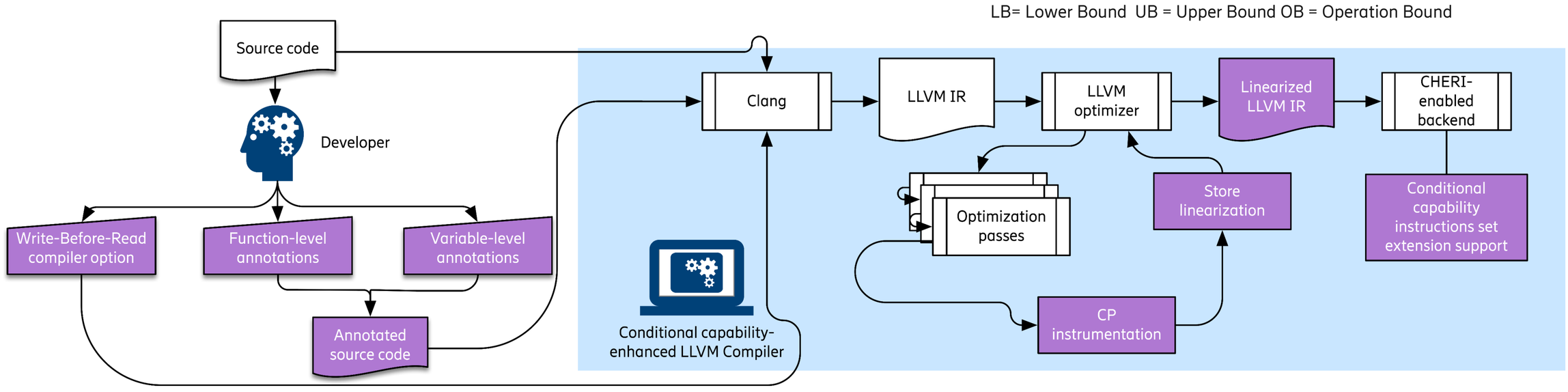
Enforce memory access policies based on prior operations
- Write-before-Read – write memory at least once before reading
- Operation-specific bound tracks area for which condition is fulfilled
- Operation bound compressed into top 16 bits of address

Evaluated using CHERI-Flute softcore and QEMU-based simulation
- Coremark: %3.5 performance overhead in addition to CHERI
- Juliet Test Suite: 100% detection with ≈ 1% false positive

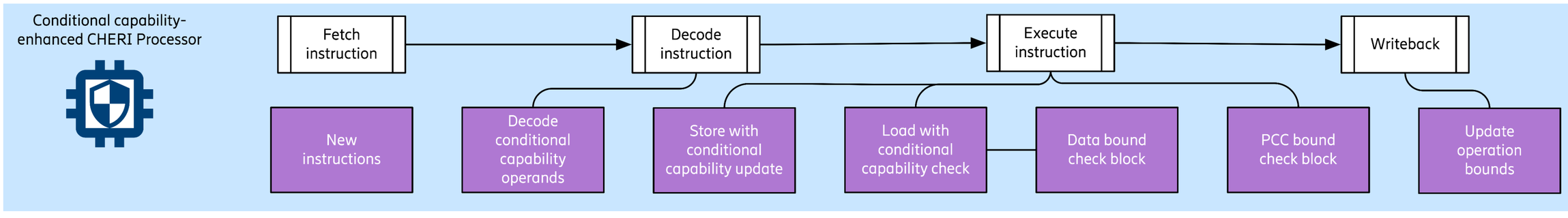


Write-before-Read capability state transitions

LB= Lower Bound UB = Upper Bound OB = Operation Bound



High-level overview of the conditional capability-enhanced LLVM compiler



Conditional capability-enhanced CHERI processor