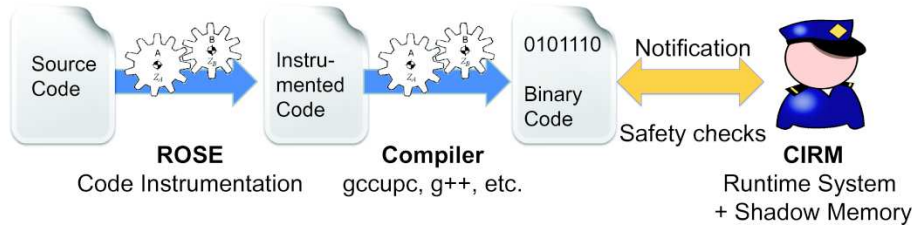


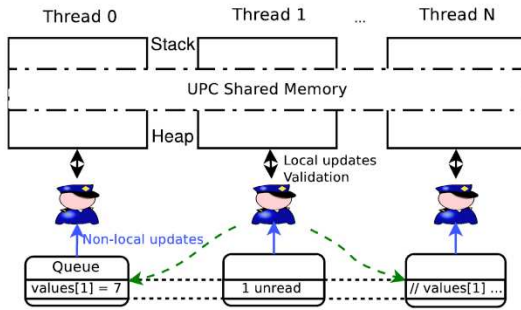


ROSE-CIRM uses the ROSE compiler framework to instrument potentially unsafe operations with calls to a runtime monitor, thereby providing a safety envelop for executing code.

The ROSE-CIRM Toolchain



CIRM Architecture



Example

```

Instrumented Code
// RTED test:c_H_1_a.upc
int upc_main()
{
  shared [] int *ptr;
  cirmCreateVar(&ptr, linit, ...);
  if (MYTHREAD == 0)
  {
    ptr = upc_alloc(...);
    cirmCreateHeapPtr(ptr, ...);
    cirmInitVar(ptr, ...);
  }
  upc_barrier();
  cirmAccessVar(&ptr, ...);
  ptr[MYTHREAD] = comp(...);
  cirmInitVar(ptr[th], ...);
}

```

Annotations for the example code:

- `cirmCreateVar(&ptr, linit, ...);`: Announces declaration of local, uninitialized variable.
- `cirmCreateHeapPtr(ptr, ...);`: Updates shadow memory and notifies other UPC threads about the heap allocation. Marks ptr as initialized.
- `cirmInitVar(ptr, ...);`: ptr in Thread 0 differs from ptr in Thread 1.
- `cirmAccessVar(&ptr, ...);`: Announces heap access through ptr. **Fails in Thread 1.**
- `ptr[MYTHREAD] = comp(...);`: **RUNTIME ERROR** ptr is only initialized in Thread 0.
- `cirmInitVar(ptr[th], ...);`: Marks ptr[th] as initialized.

UPC Bounds Checking

Address	Threads	0	1	2	3	
0x50		0	3	6	9	chararr[0]
0x51		1	4	7	10	
0x52		2	5	8	11	chararr[1]
0x53		12	15	18	21	
0x54		13	16	19	22	chararr[2]
0x55		14	17	20	23	
0x56		24	27	30	33	chararr[3]
0x57		25	28	31	34	
0x58		26	29	32	35	

shared[3] char chararr[THREADS][8]

Results on UPC Error Benchmark

Luecke et al.: UPC Run Time Error Detection Test Suite. High Performance Computing Group at Iowa State

Category	Number of tests	Correctly Identified (in percent)
Out of bounds accesses (indices)	726	685 (94%)
Out of bounds accesses (pointers)	160	150 (94%)
Uninitialized memory reads	64	62 (97%)
Dynamic memory handling related	10	10 (100%)

