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Functional Verification Strategy for an Open-Source High-Performance L1 Data-Cache for RISC-V cores

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HP Dcache TOP

- Data-Cache
- High performance
- Highly configurable
- For RISC-V cores

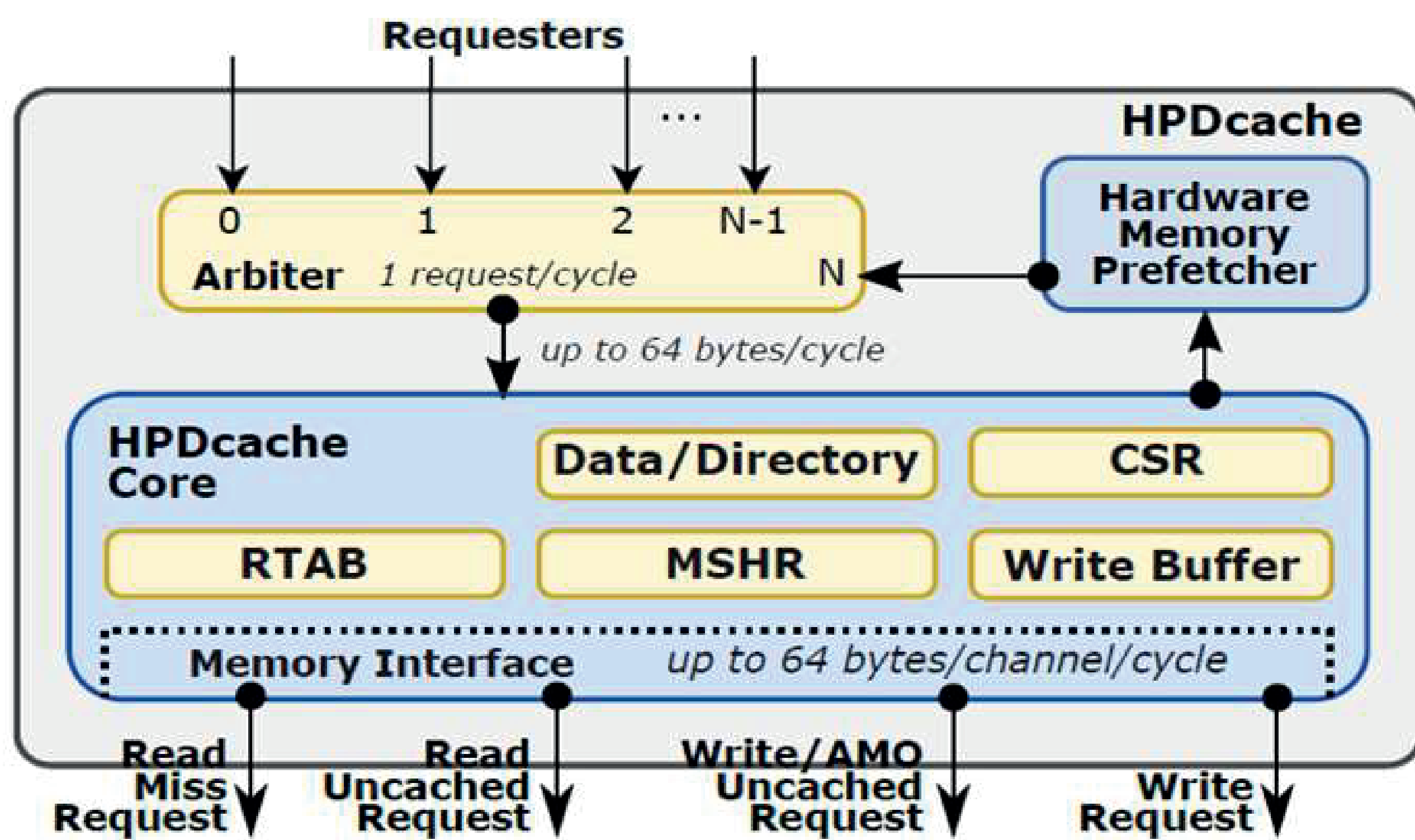
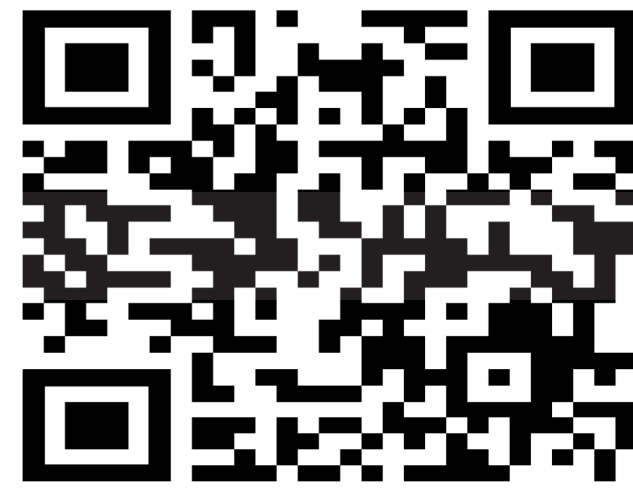


Fig 1. HPDcache TOP

UVM Testbench

- An out-of-order memory response model
- HPDcache request agent
- Memory partition agent
- Reset, clock and back-pressure drivers, watch dog, etc
- SV sources will be delivered in Open-Source

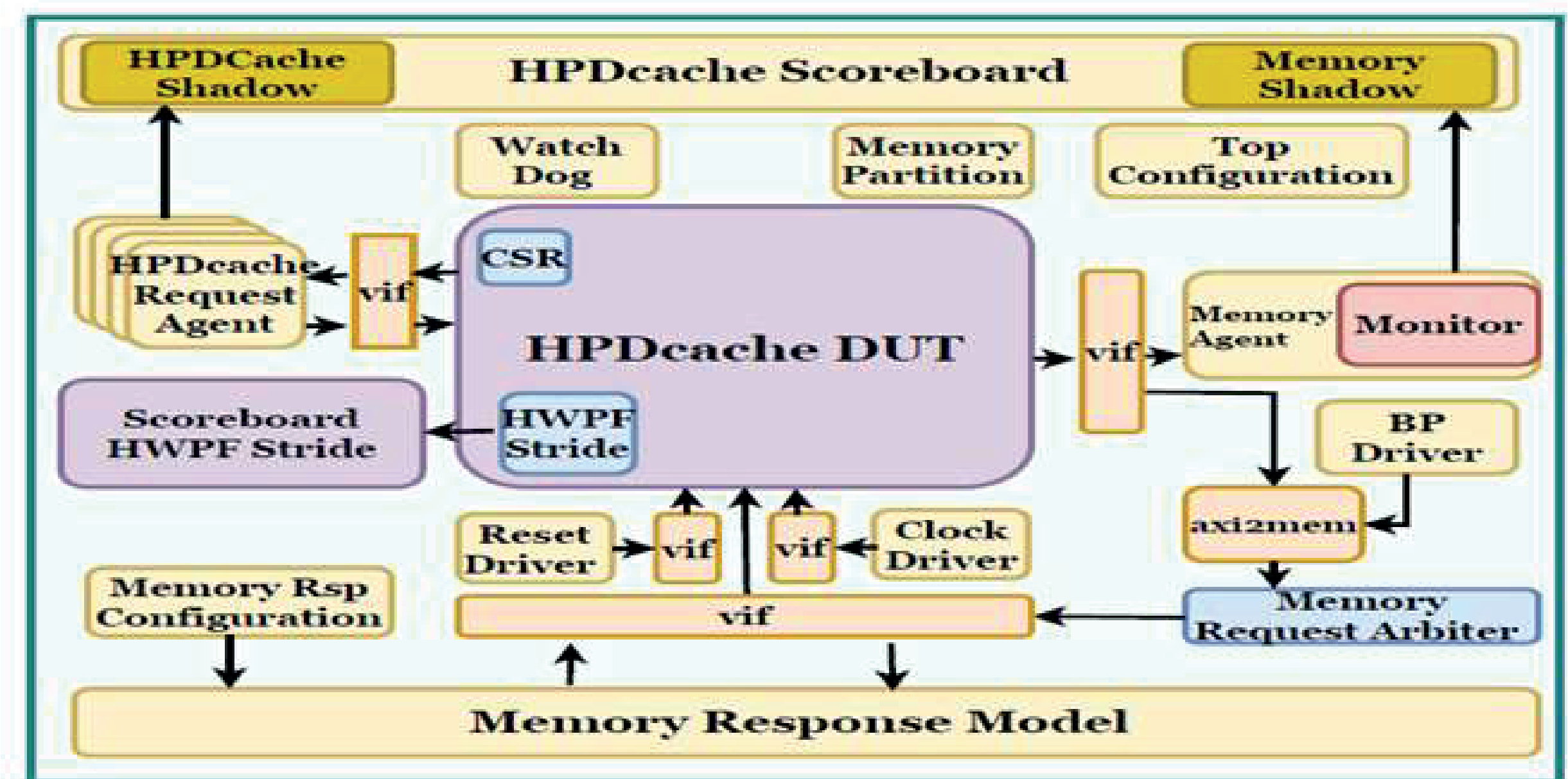


Fig 2. UVM Testbench Environment

Coverage/Assertion Driven Verification

- Assertion Schmoos
- Cover bins
- Cross coverage

```

for(clk_delay_itr=0; clk_delay_itr<= 5 ; clk_delay_itr++) begin: clk_delay_itr
property mem_req_rd_miss_tmp_schmoos_prop;
dcache_set_t set;
dcache_tag_t tag;
@(posedge clk_i)

(arb_req_valid & arb_req_ready,
set = dcache_req_set,
tag = dcache_req_tag) |-> ##clk_delay_itr
(mem_req_miss_read_valid_o & mem_req_miss_read_ready_i
& mem_rd_miss_set == set & mem_rd_miss_tag == tag);
endproperty
mem_req_rd_miss_tmp_schmoos_cov:cover property (
em_req_rd_miss_tmp_schmoos_prop )
end
    
```

```

cov_size: coverpoint packet.size
{
bins size_0 = {'h0};
bins size_1 = {'h1};
.....
bins size_7 = {'h7};
}
    
```

```

cov_cross_op_need_rsp : cross cov_need_rsp, cov_op;
cov_cross_op_uncacheable : cross cov_uncacheable, cov_op;
cov_cross_op_set : cross cov_set, cov_op;
cov_cross_op_size : cross cov_op, cov_size;
    
```

```

cov_op: coverpoint packet.op
{
bins op_load = {DCACHE_REQ_LOAD };
bins op_store = {DCACHE_REQ_STORE };
bins op_amo_lr = {DCACHE_REQ_AMO_LR };
.....
bins op_amo_minu = {DCACHE_REQ_AMO_MINU};
bins op_cmo = {DCACHE_REQ_CMO };
}
    
```

Compile Time Parameters

- HP Dcache has 19 different parameters
- Can give millions of possible configurations
- A new generic tool is developed to generate different sets of configurations

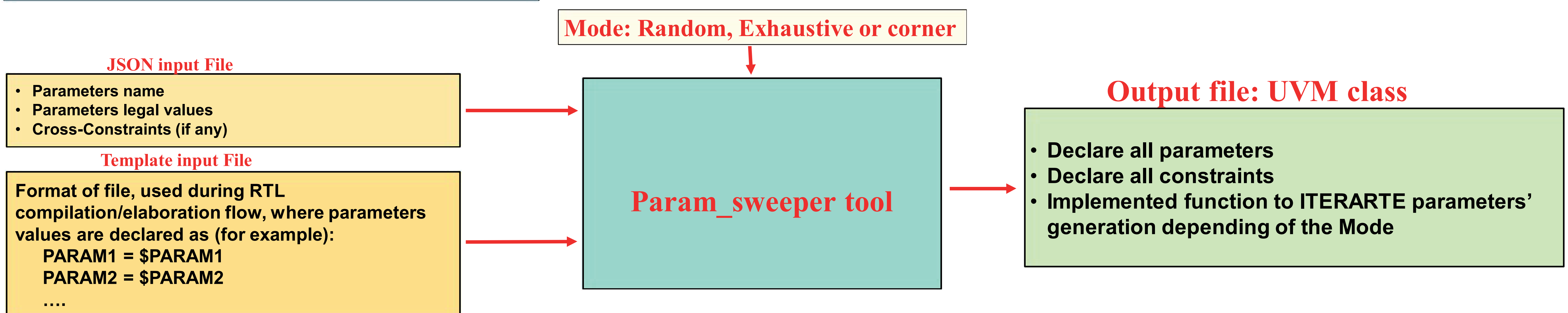


Fig 3. Compile Time Parameters