The SystemC Simulation Engine

An Interactive Exploration of an Event Driven Simulator

Doulos Inc.
David C. Black, Senior Member Technical Staff

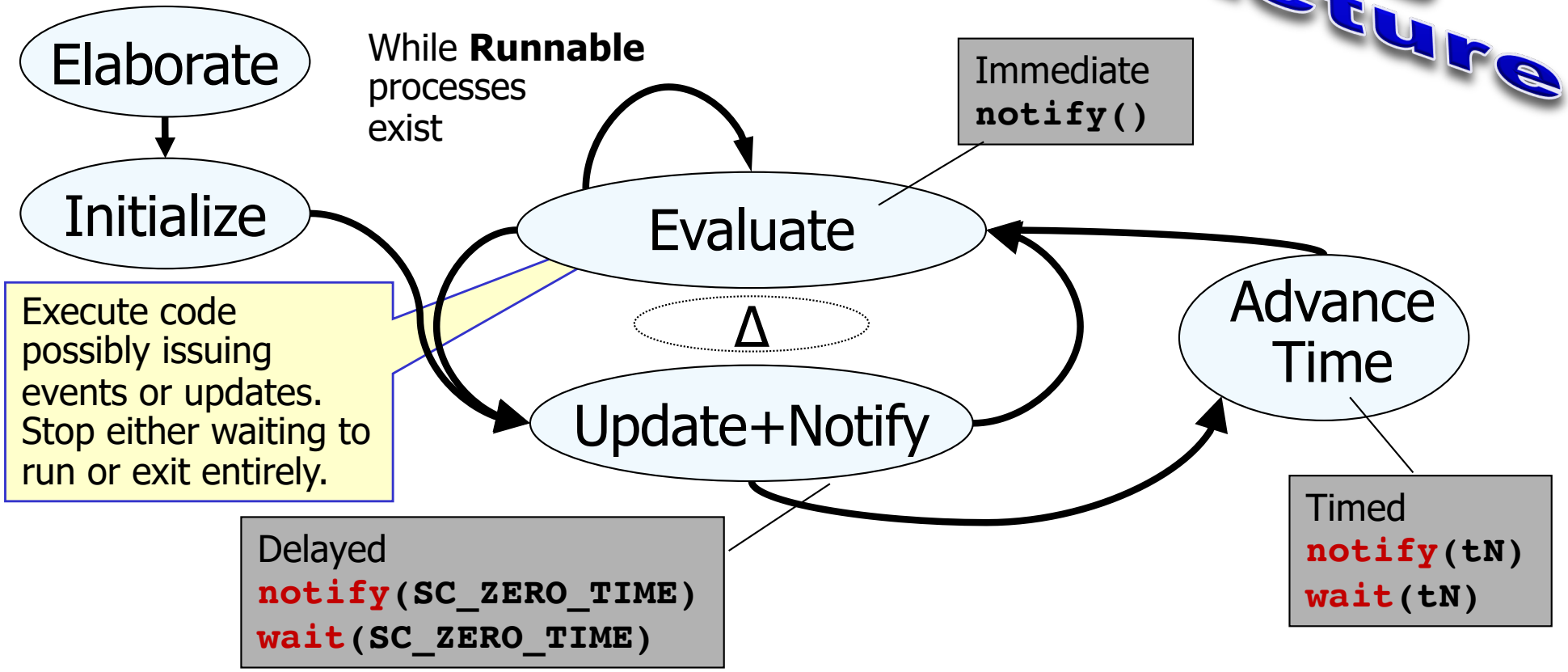
Copyright Permissions

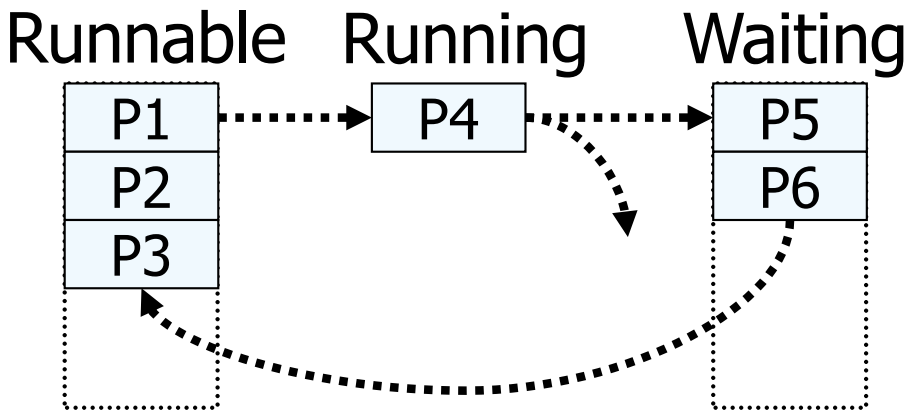
Agenda & Goals

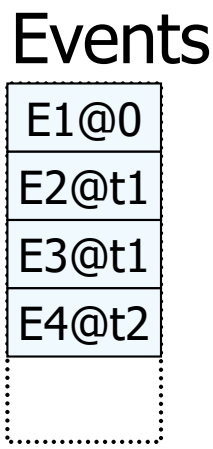
- Overview of flow diagram and queues
- SystemC constructs used
- Example code
- Step-by-step walk-thru
  - Illustrate each step of simulation
  - Understand events & delta cycles
- References

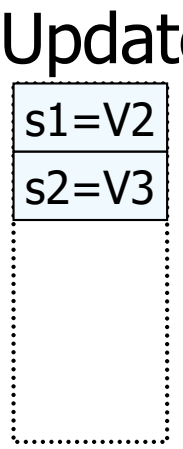
Simulation Engine

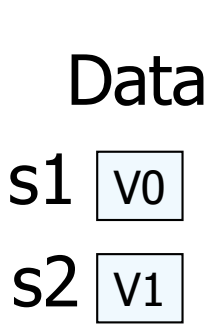
Big Picture



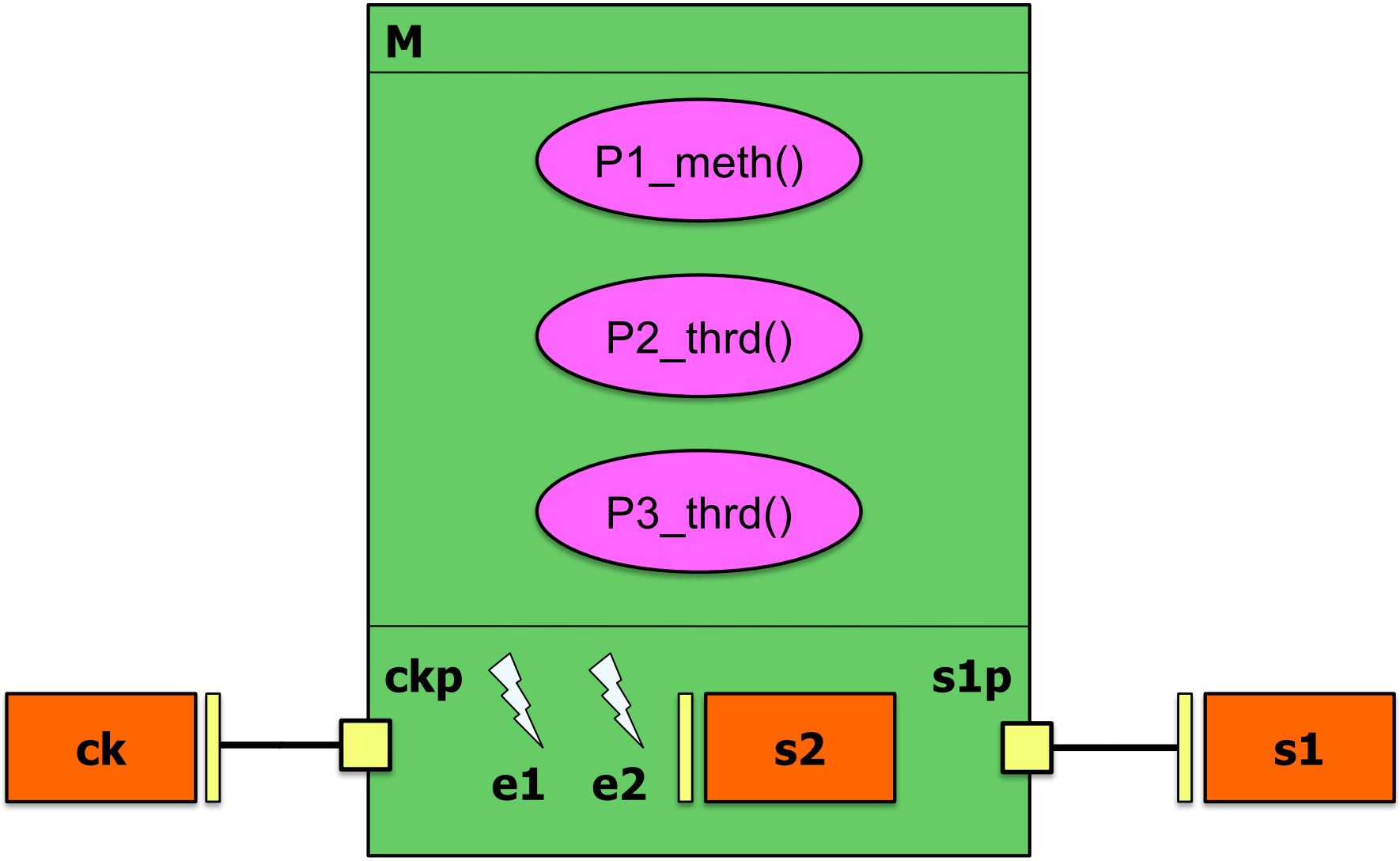








Example Design



SystemC constructs used herein

- **SC_MODULE**, **SC_CTOR** - used to create modules
- **SC_THREAD**[1], **SC_METHOD**[1] - types of processes
- **sensitive**, **dont_initialize** - attributes of processes
- **sc_event**, **wait**[2], **notify**[3] - synchronization mechanisms
- **sc_signal**[4], **read**, **write** - primitive channel
- **sc_clock** - **sc_signal**<**bool**> with a generating process
- **sc_in** - **sc_port**<> specialization of type **sc_signal_in_if**<>
- **sc_out** - **sc_port**<> specialization of type **sc_signal_out_if**<>

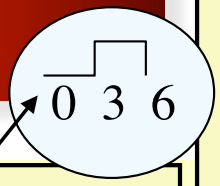
[1] Verilog **initial** or **always** block; VHDL **process** block

[2] Verilog **@**, **#**, or **wait** statement; VHDL **wait** statement

[3] Verilog **->** statement, except SystemC is more flexible

[4] Verilog **wire** or **var** with **<=** type; VHDL **signal** type

Example SystemC




```
sc_clock ck("ck",6,0.5,3);
SC_MODULE(M) {
  sc_in<bool> ckp;//in  port
  sc_out<int> s1p;//out port
  sc_signal<int> s2;
  sc_event e1, e2;
  void P1_meth();
  void P2_thrd();
  void P3_thrd();
  SC_CTOR(M):temp(9){
    SC_THREAD(P3_thrd);
    SC_THREAD(P2_thrd);
      sensitive<<ckp.pos();
    SC_METHOD(P1_meth);
      sensitive<<s2;
      dont_initialize();
  }//end SC_CTOR
 private:
  int temp;
};
```

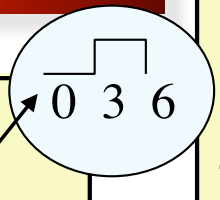
Executed during elaboration

```
void M::P1_meth() {
  temp = s2.read();
  s1p->write(temp+1);
  e2.notify(2,SC_NS);//timed
}
void M::P2_thrd() {
A:s2.write(5);
  e1.notify();//immediate
  wait();
B:for (int i=7;i<9;i++){
    s2.write(i);
    wait(1,SC_NS);
C:  e1.notify(SC_ZERO_TIME);
    wait();//static sensitive
  }//endfor
}
void M::P3_thrd() {
D:while(true) {
    wait(e1|e2);
E:  cout << "time "
    <<sc_time_stamp()<<endl;
  }//endwhile
}
```

//delayed

Simulation

Example SystemVerilog




```
module M
   int temp = 9;
   bit ck; always #3 ck++;
   int s1p;//out port
   int s2;
   event e1, e2;
endmodule
```

```
P1_meth: always @(s2) begin
   temp = s2;
   s1p <= temp+1;
   ->>#2ns e2;//timed
end
P2_thrd: initial begin
A:s2 <= 5;
   ->>e1;//immediate
   @(posedge ck);
B:for (int i=7;i<9;i++) begin
      s2 <= i;
      #1ns;
C:    ->>#0 e1;//delayed
      @(posedge ck);
   end
end
P3_thrd: initial begin
D:while(1) {
      @(e1 or e2);
E:    $display("time %t",$time);
   end: D
end
```

Executed during elaboration

Simulation