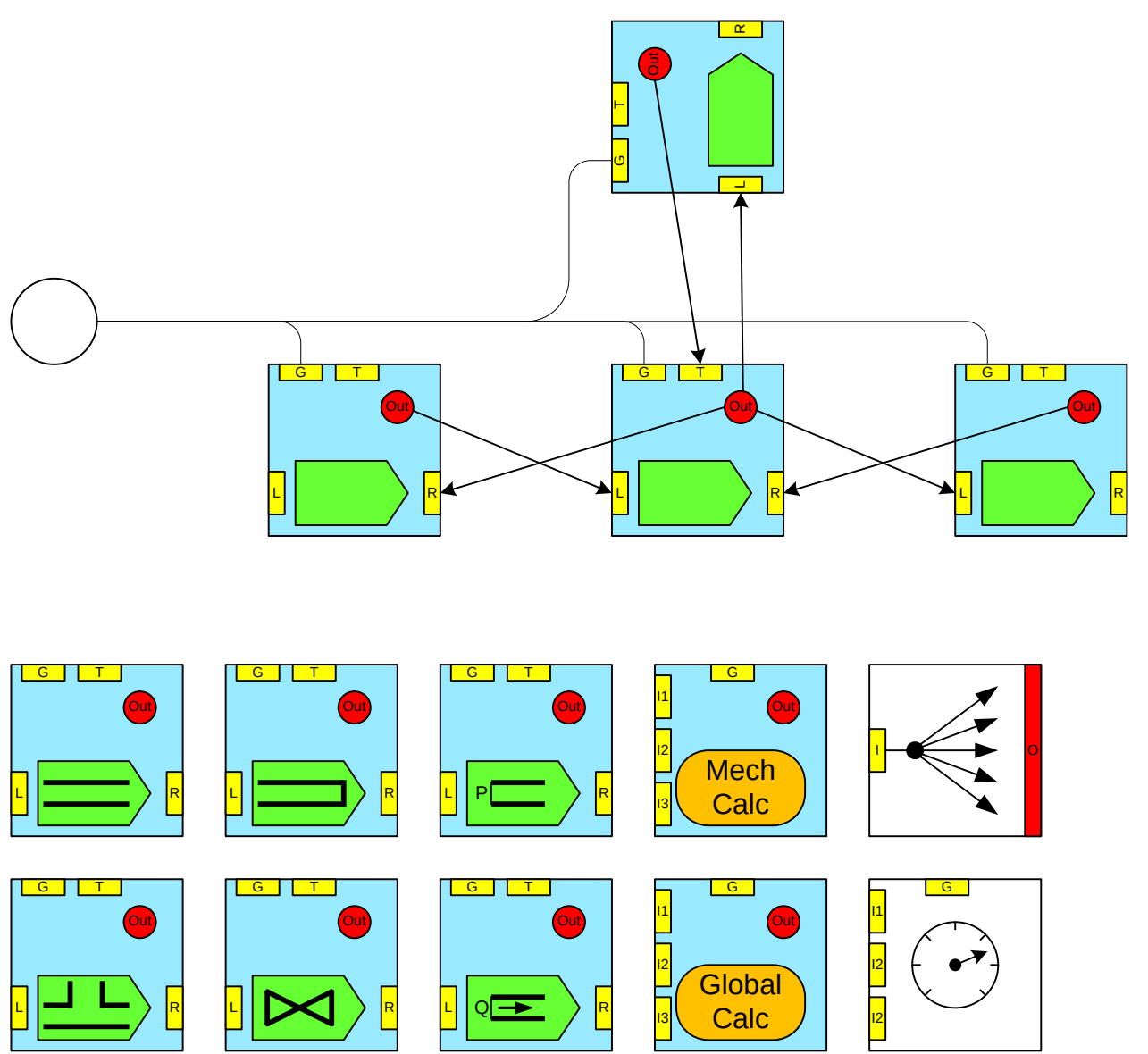
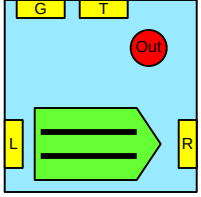
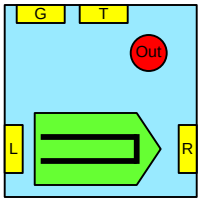
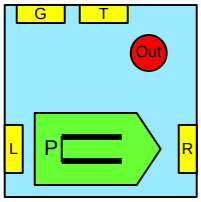

R
Out
T
G
┘
G
T
Out
L
R
G
T
Out
L
R
G
T
Out
L
R
G
T
Out
L
R
G
T
Out
L
R
G
T
Out
L
P
R
G
I1
I2
I3
Out
Mech
Calc
I
O
G
T
Out
L
R
G
T
Out
L
R
G
T
Out
L
Q
R
G
I1
I2
I3
Out
Global
Calc
G
I1
I2
I2



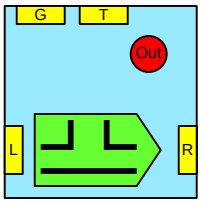
Pipe Segment



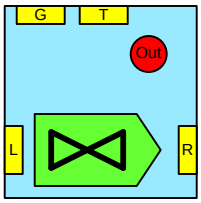
End Cap



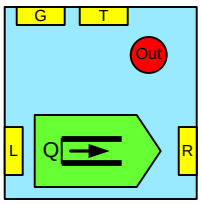
Defined Pressure Source



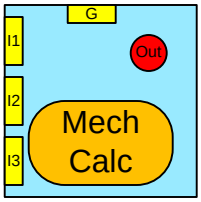
Pipe “T”



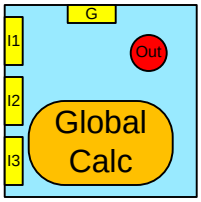
Valve



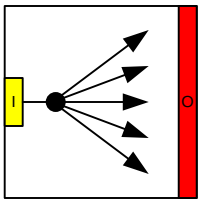
Defined Flow Source



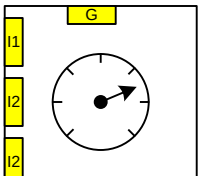
Mechanical Component



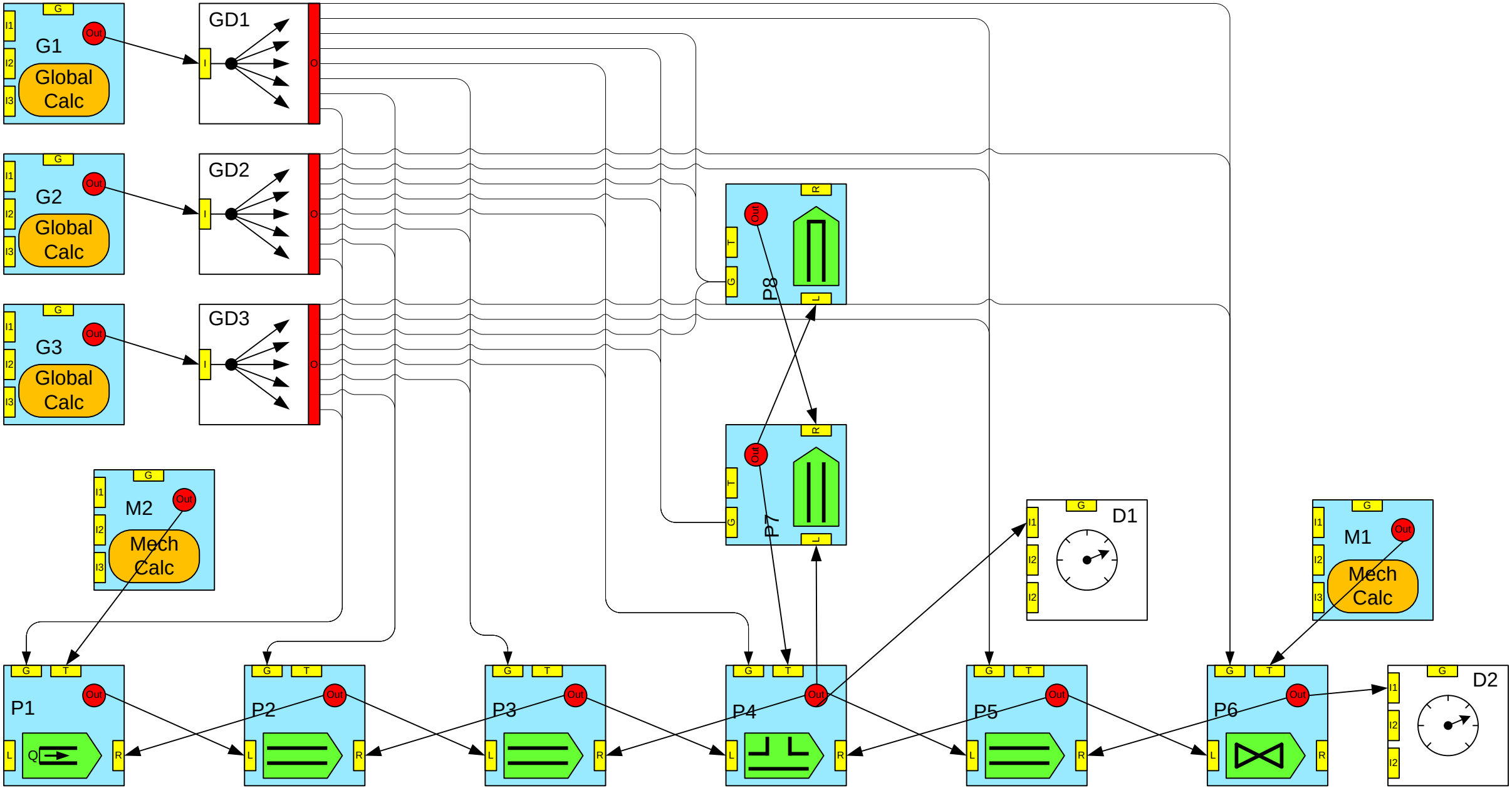
Global Calculation

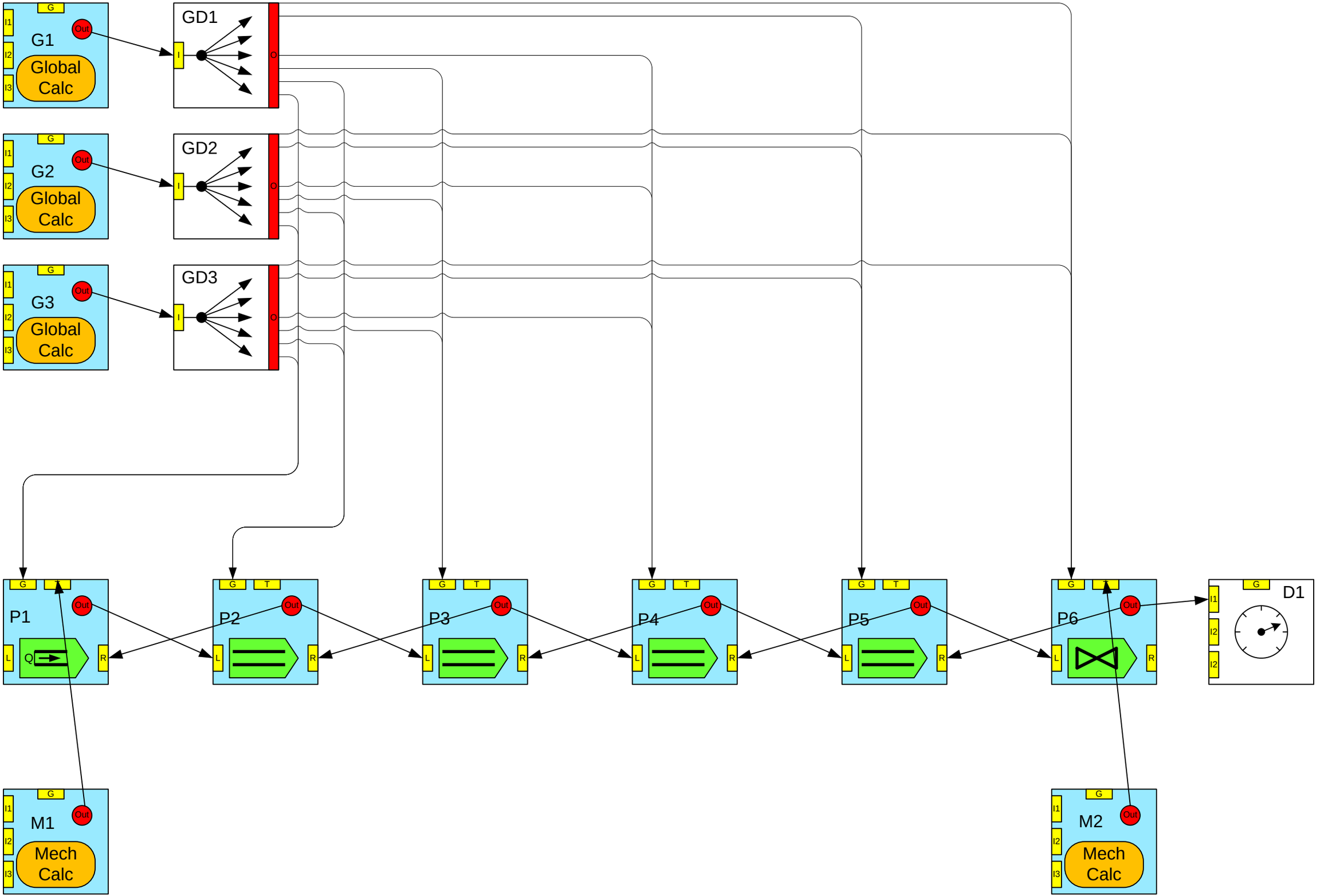


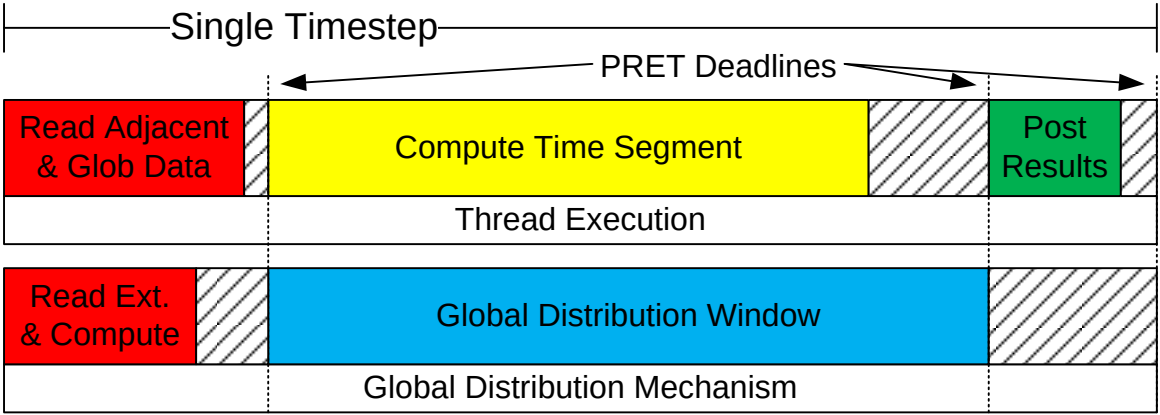
Global Distribution

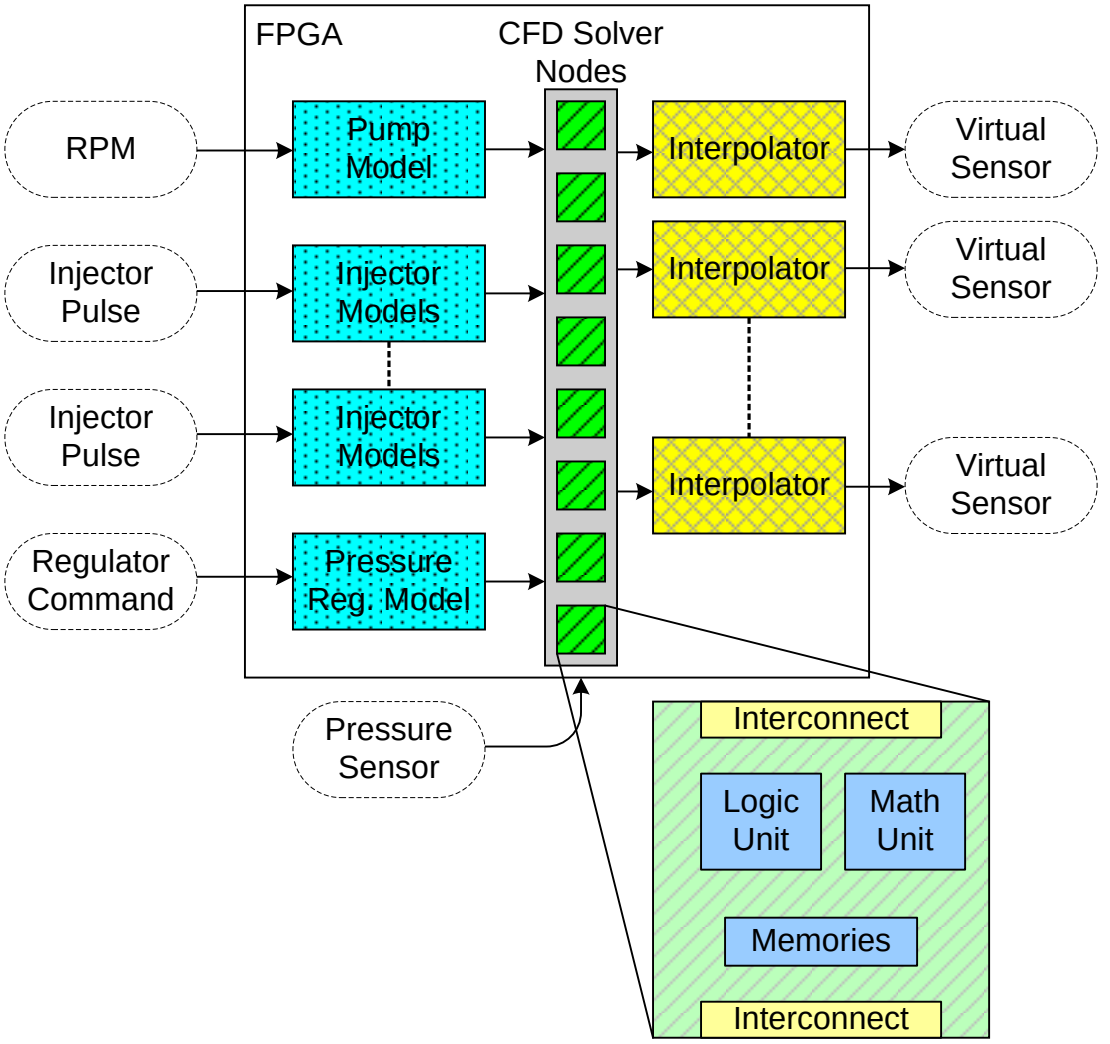


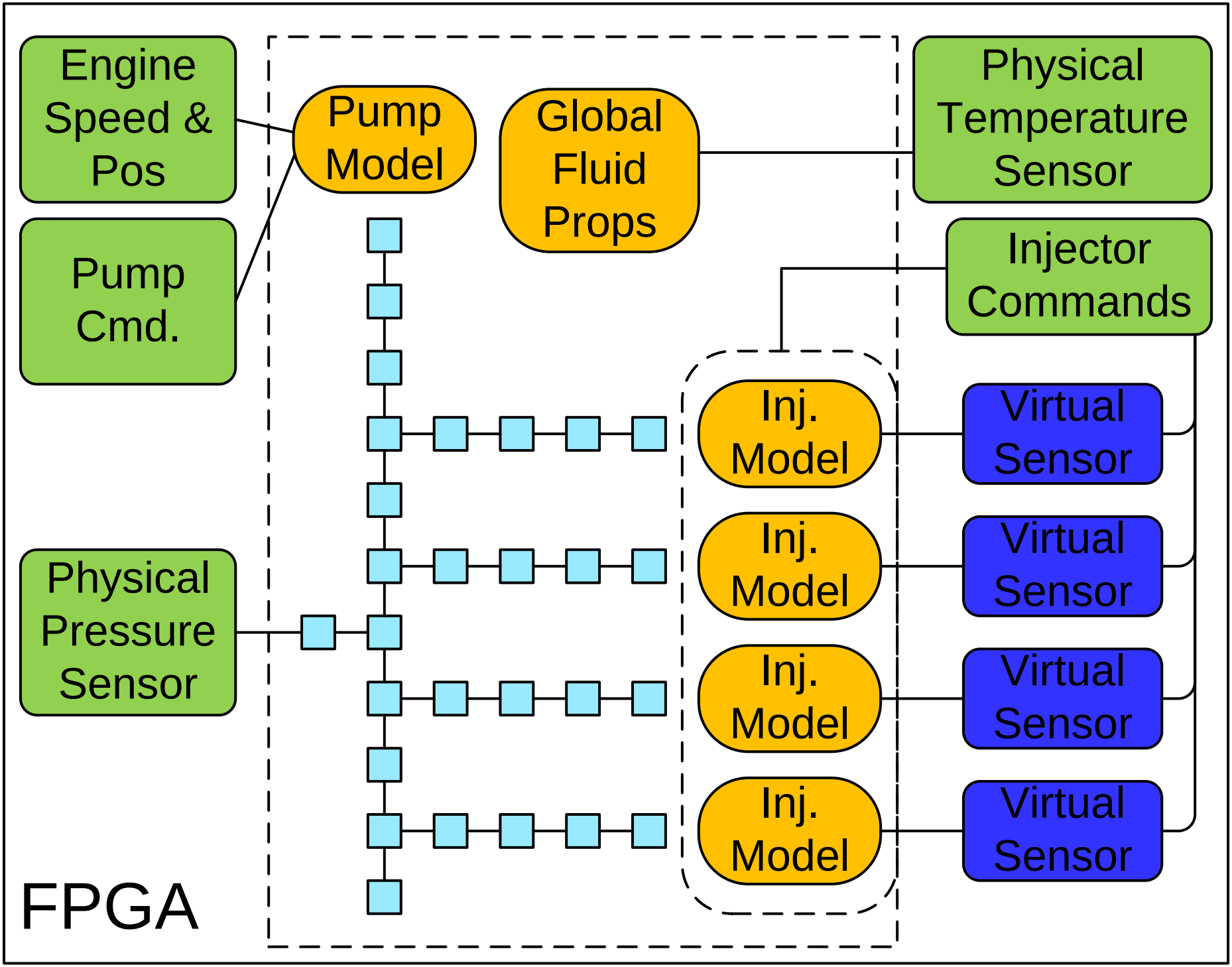
Display/Post Data

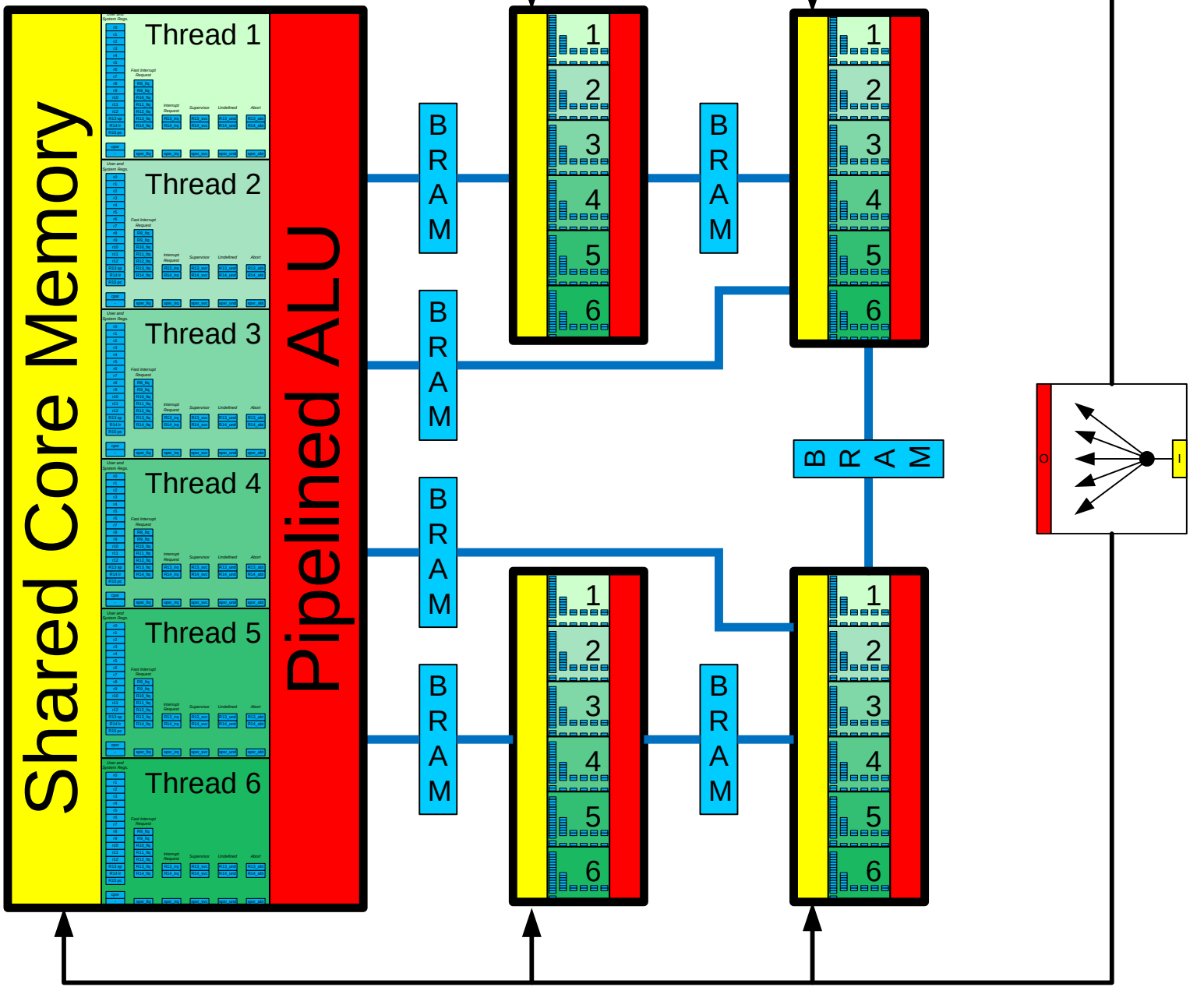

G1
Global Calc
G2
Global Calc
G3
Global Calc
GD1
GD2
GD3
M2
Mech Calc
M1
Mech Calc
P8
P7
D1
D2
P1
P2
P3
P4
P5
P6
Out
I1
I2
I3
G
T
L
R
Q

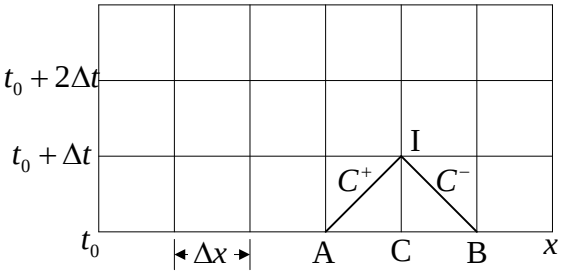

G1
Global Calc
G2
Global Calc
G3
Global Calc
GD1
GD2
GD3
P1
P2
P3
P4
P5
P6
D1
M1
Mech Calc
M2
Mech Calc

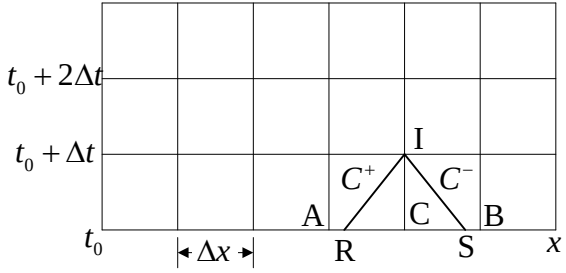

Single Timestep
PRET Deadlines
Read Adjacent & Glob Data
Compute Time Segment
Post Results
Thread Execution
Read Ext. & Compute
Global Distribution Window
Global Distribution Mechanism

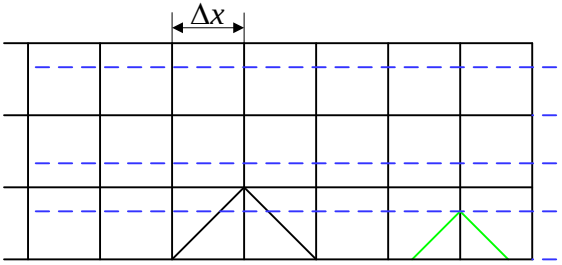

FPGA
CFD Solver Nodes
RPM
Pump Model
Injector Pulse
Injector Models
Injector Pulse
Injector Models
Regulator Command
Pressure Reg. Model
Interpolator
Interpolator
Interpolator
Virtual Sensor
Virtual Sensor
Virtual Sensor
Pressure Sensor
Interconnect
Logic Unit
Math Unit
Memories
Interconnect

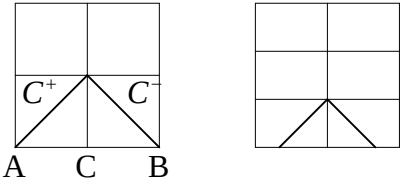

Engine Speed & Pos
Pump Cmd.
Physical Pressure Sensor
Pump Model
Global Fluid Props
Physical Temperature Sensor
Injector Commands
Inj. Model
Inj. Model
Inj. Model
Inj. Model
Virtual Sensor
Virtual Sensor
Virtual Sensor
Virtual Sensor
FPGA

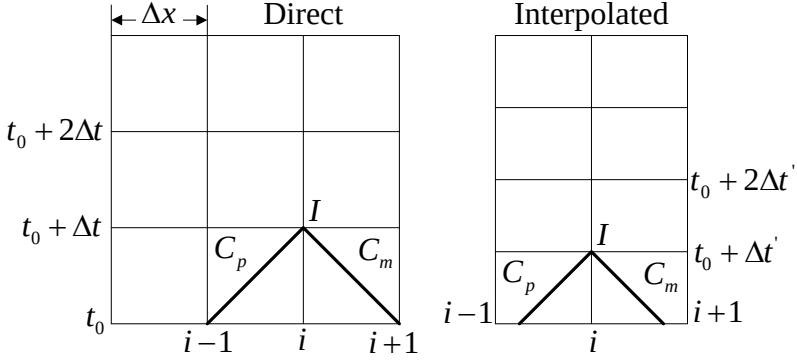

Shared Core Memory
Thread 1
Thread 2
Thread 3
Thread 4
Thread 5
Thread 6
Pipelined ALU
BRAM
BRAM
BRAM
BRAM
BRAM
BRAM
BRAM
1
2
3
4
5
6
O
I

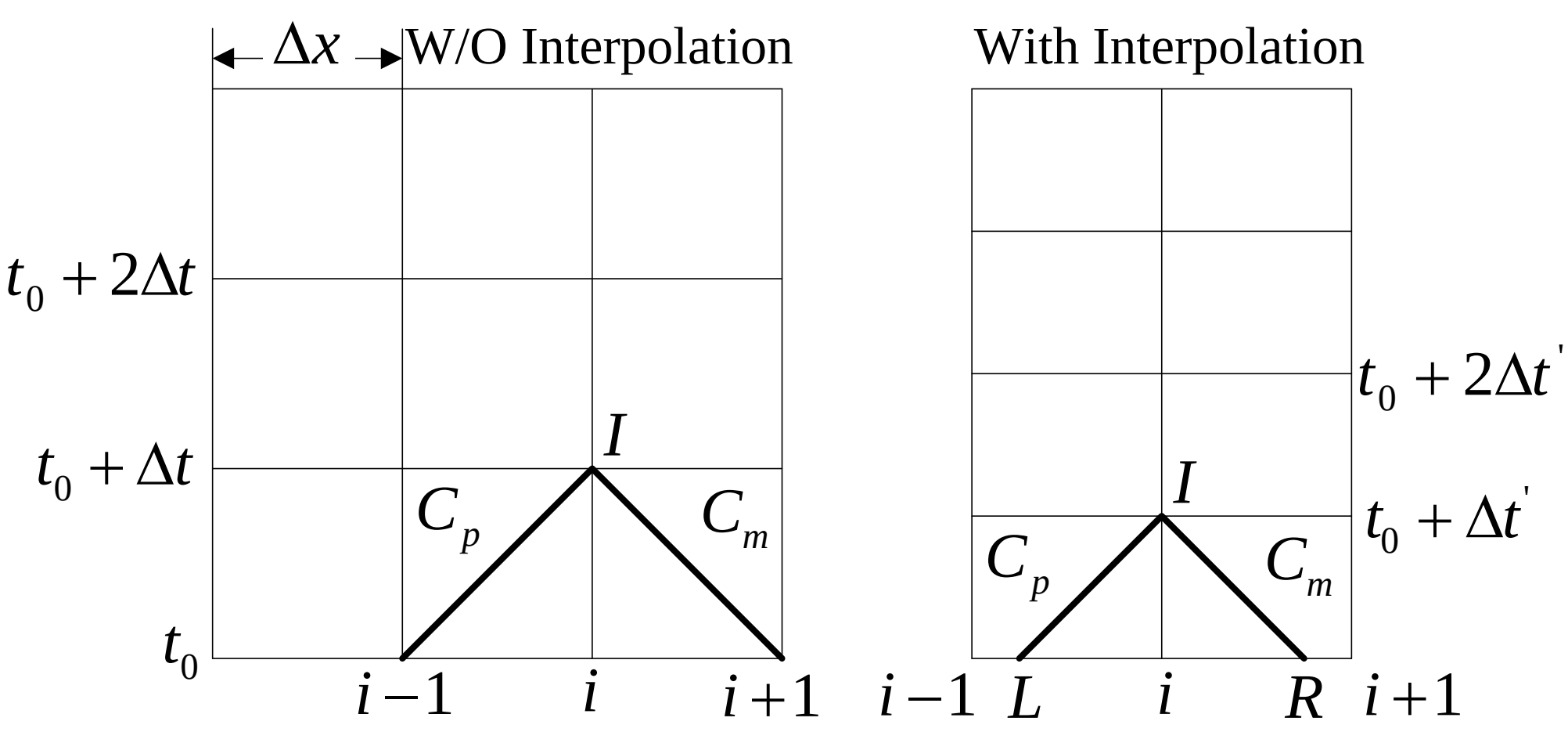

$t_0 + 2\Delta t$
$t_0 + \Delta t$
t_0
Δx
I
C^+
C^-
A
C
B
x

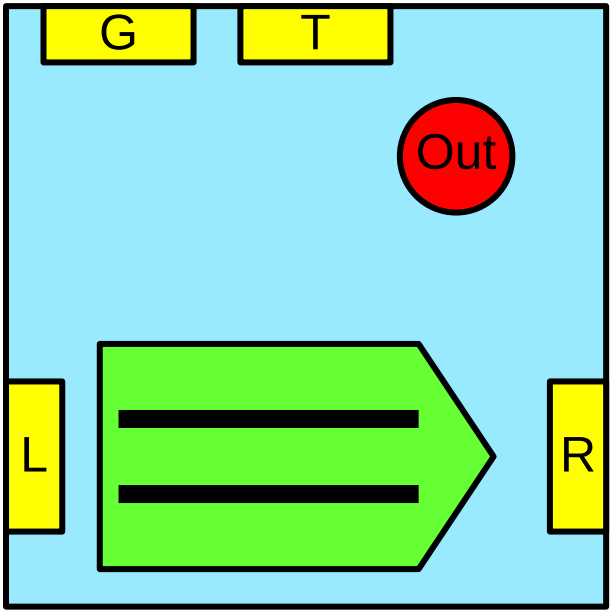

$t_0 + 2\Delta t$
$t_0 + \Delta t$
t_0
Δx
I
C^+
C^-
A
C
B
R
S
x

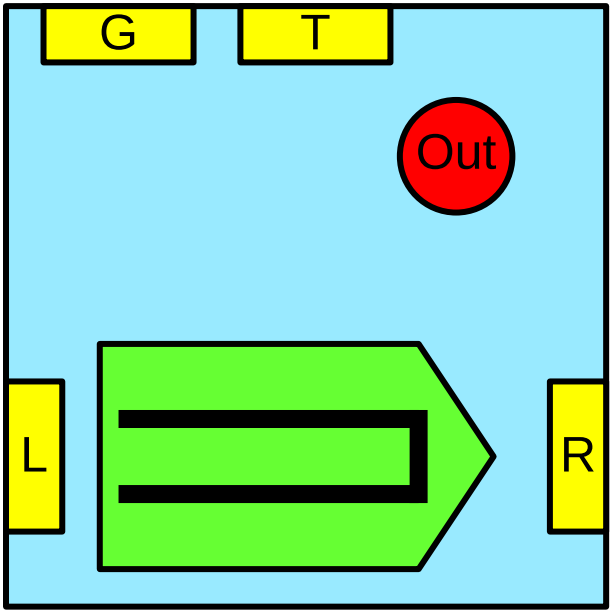

Δx

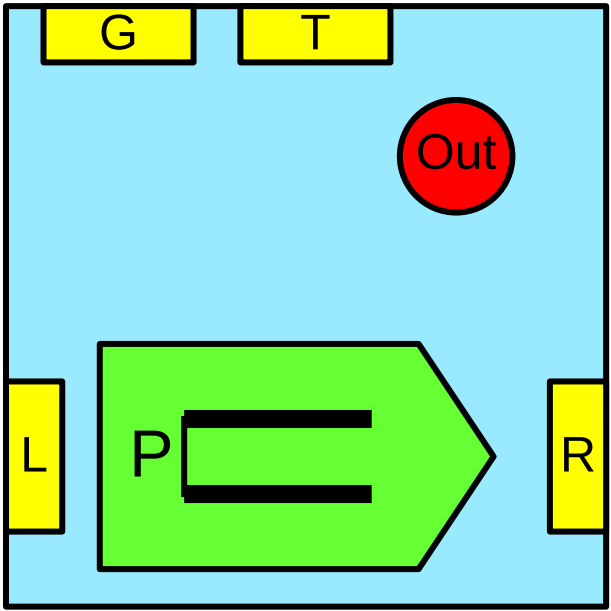

C^+
C^-
A
C
B

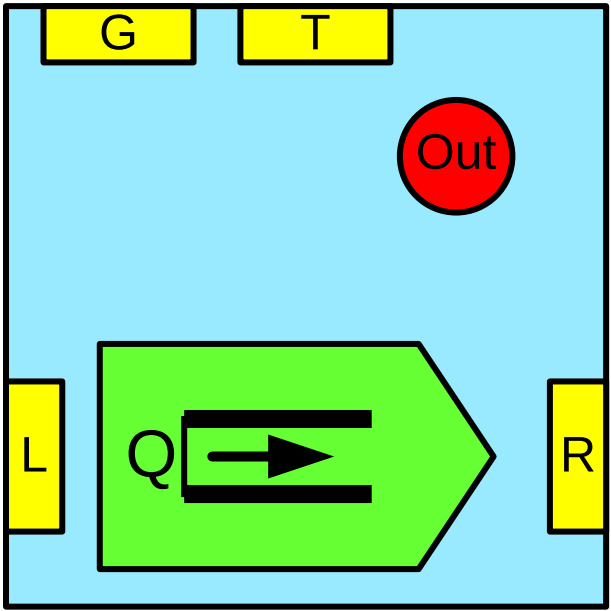

Δx
Direct
Interpolated
$t_0 + 2\Delta t$
$t_0 + \Delta t$
t_0
I
C_p
C_m
$i-1$
i
$i+1$
$t_0 + 2\Delta t'$
$t_0 + \Delta t'$

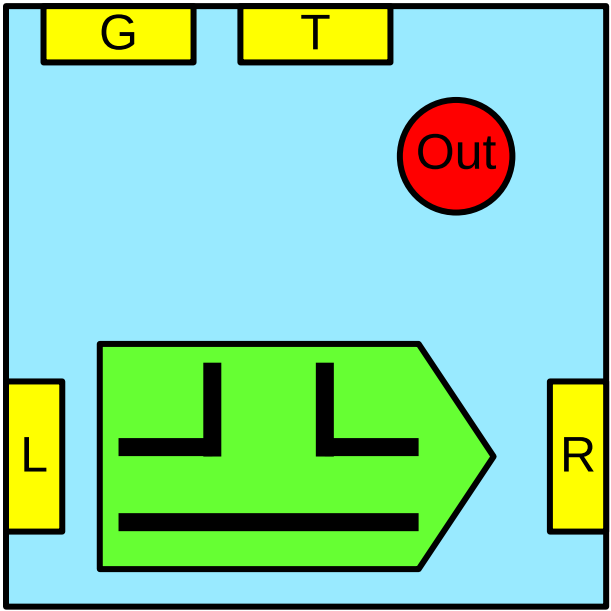

Δx
W/O Interpolation
With Interpolation
$t_0 + 2\Delta t$
$t_0 + \Delta t$
t_0
I
C_p
C_m
$i-1$
i
$i+1$
$t_0 + 2\Delta t'$
$t_0 + \Delta t'$
I
C_p
C_m
$i-1$
L
i
R
$i+1$

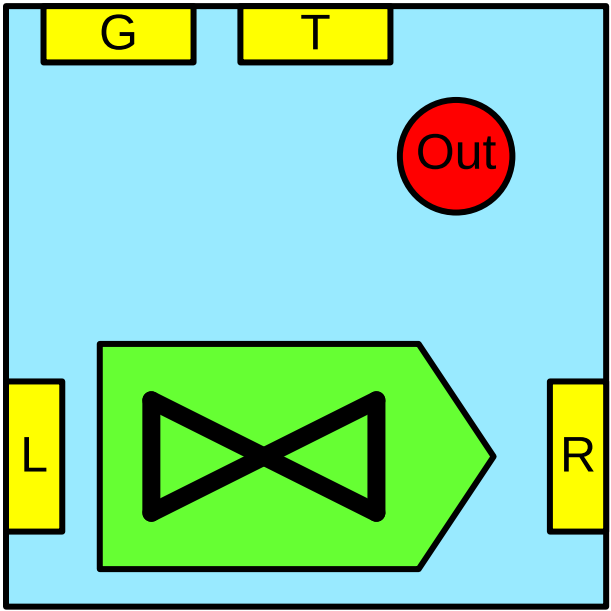

G
T
Out
L
R

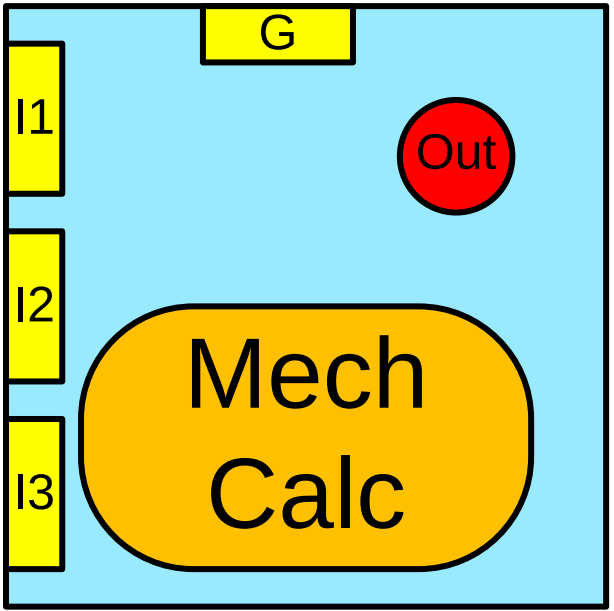

G
T
Out
L
R

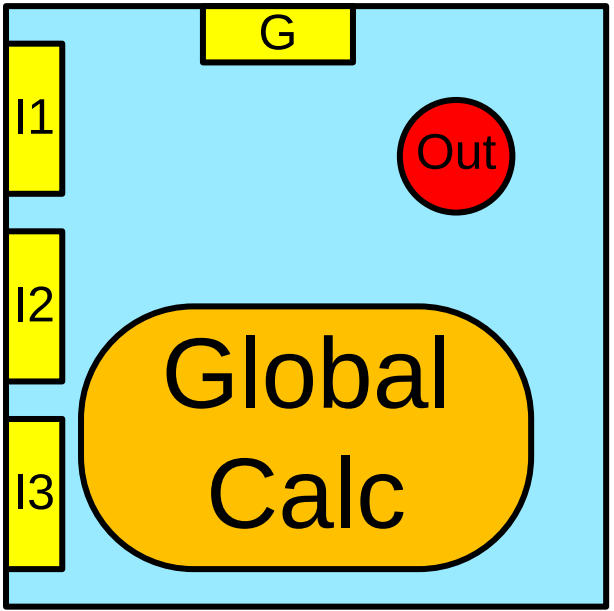

G
T
Out
L
P
R

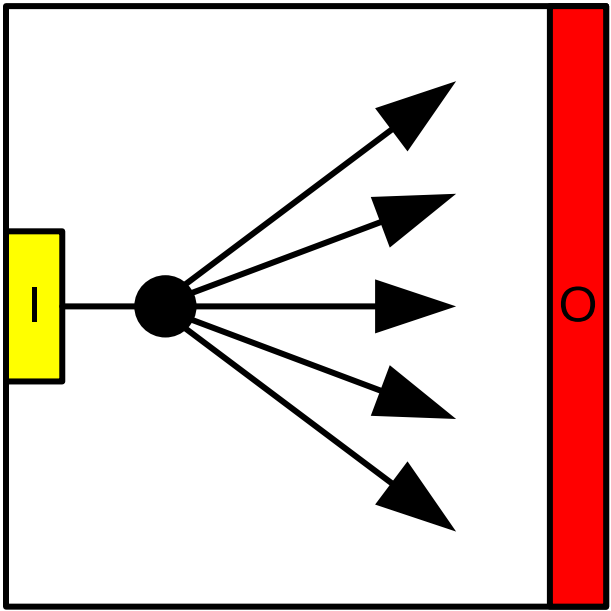

G
T
Out
L
Q
R

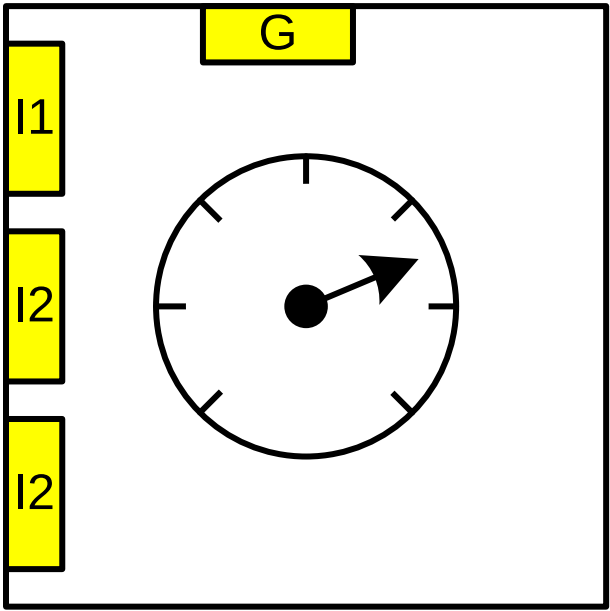

G
T
Out
L
R

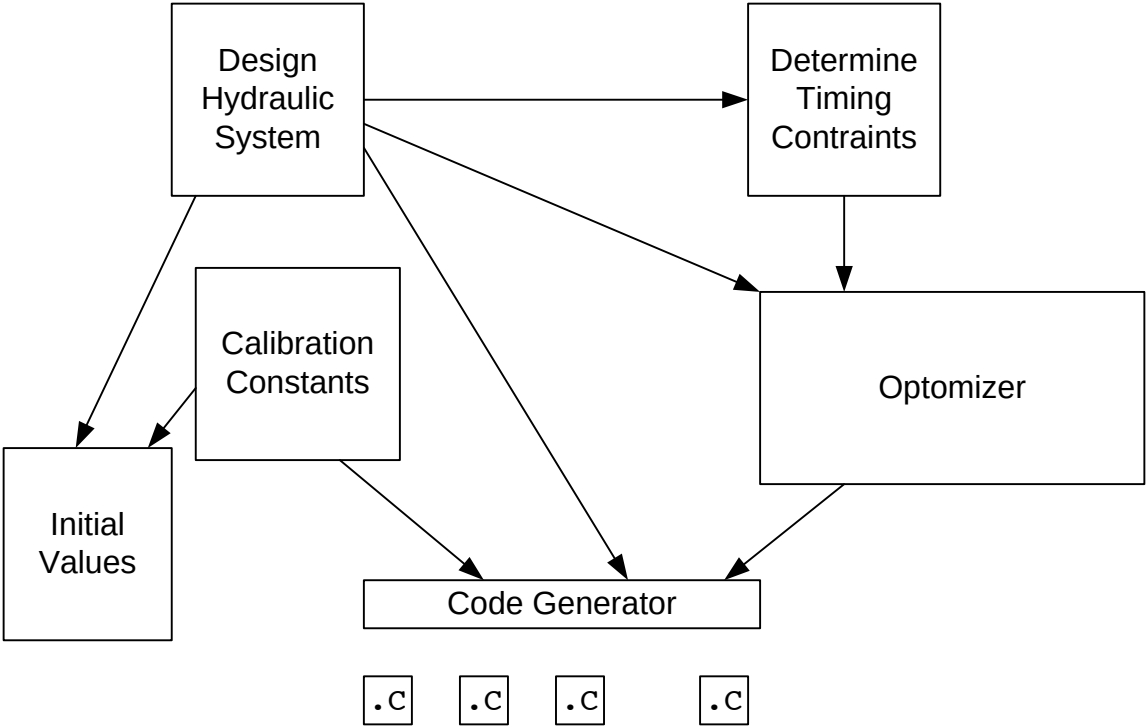

G
T
Out
L
R

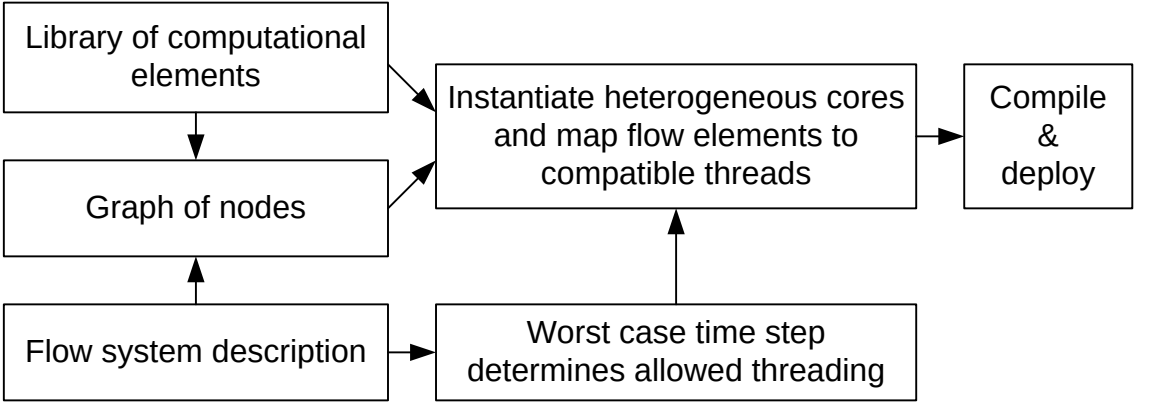

G
I1
Out
I2
Mech
Calc
I3


G
I1
Out
I2
Global
Calc
I3


I
O


G
I1
I2
I2


Design Hydraulic System
Determine Timing Contraints
Calibration Constants
Optomizer
Initial Values
Code Generator
.c
.c
.c
.c


Library of computational elements
Graph of nodes
Flow system description
Instantiate heterogeneous cores and map flow elements to compatible threads
Worst case time step determines allowed threading
Compile & deploy