LABORATOIRE DE L'ACCÉLÉRATEUR LINÉAIRE
cnrs IN2P3 Les deux infinis

Julius Hrivnac, LAL

Implementing Parallel Algorithms
Swarm – Multithreaded Framework

continuation of Minerva project

Basic principles:
- ➢multithreading should not obscure the implementation of algorithms
- ➢a user should see the program logic, not parallelisation artifacts
- ➢thread scheduling and balancing should be automatic

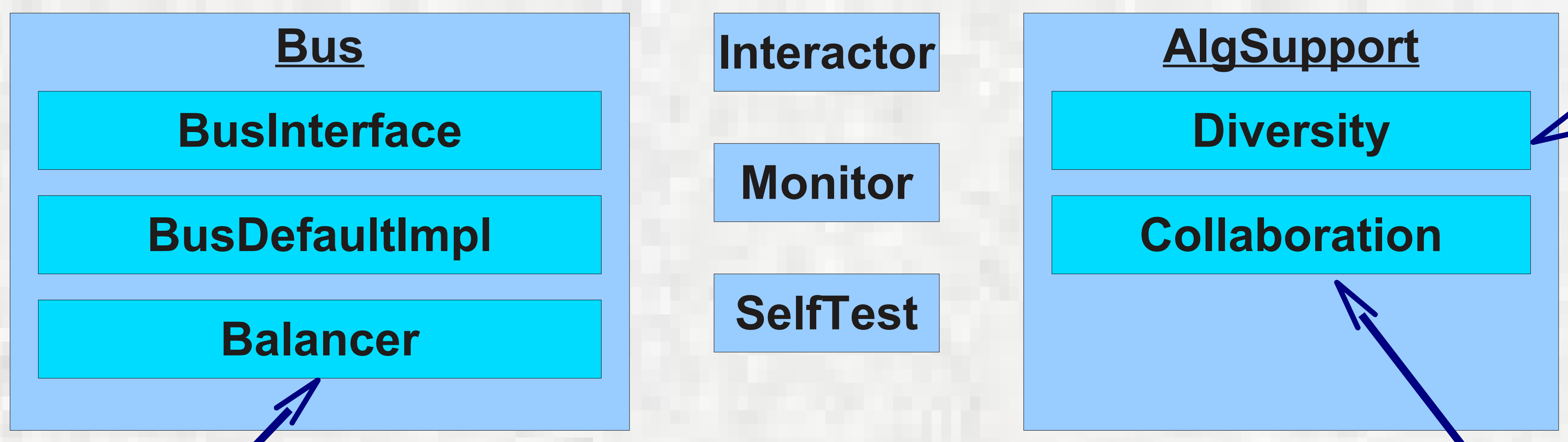
Two levels of parallelism:
- ➢parallel Consumers/Producers
- ➢*Fork&Join* algorithms on parallel containers

Uses:
- ➢Java 7
- ➢ObjectBrowser
- ➢Colt
- ➢JUNG
- ➢BeanShell
- ➢FreeHEP
- ➢Generic Collections
- ➢Concurrent
- ➢Log4J
- ➢Groovy
- ➢Scala
- ➢Clojure

Architecture:
- ➢based on the classical *Producer-Consumer InfoBus* pattern
- ➢all *BusMember*s declare their input/output *BusItem* types, including possible multiplicity (one BusItem processed by several Consumers)
- ➢pluggable *Balancer* orchestrates Producer/Consumer threads to optimize performance

Design:
- ➢based on advanced multithreaded architecture of Java 7
- ➢allows BusMembers in JVM-compatible multithreaded languages (*Groovy*, *Scala*, *Clojure*)
  - ➢possibility to re-write a part of the framework in those languages foreseen
- ➢completely interactive with the graphical interface (various Observers)

Future Evolution:
- ➢persistency (Parallel IO)
- ➢distributed operation



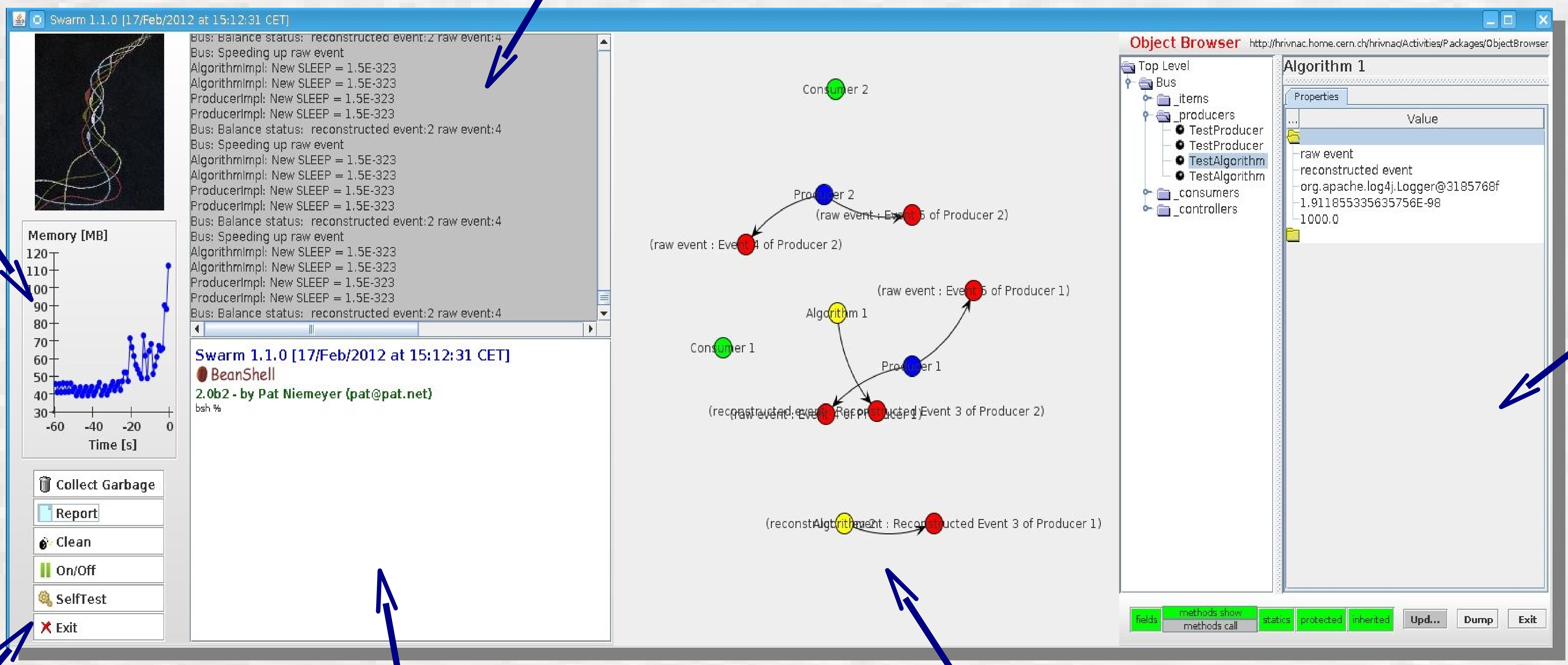
support for multiple languages

thread scheduling and balancing

support for Fork & Join Containers

Memory consumption

Processing Log


Swarm 1.1.0 [17/Feb/2012 at 15:12:31 CET]
Memory [MB]
120
110
100
90
80
70
60
50
40
30
-60
-40
-20
0
Time [s]
Collect Garbage
Report
Clean
On/Off
SelfTest
Exit
Consumer 2
Producer 2
(raw event : Event 5 of Producer 2)
(raw event : Event 4 of Producer 2)
(raw event : Event 5 of Producer 1)
Algorithm 1
Consumer 1
Producer 1
(reconstructed event : Reconstructed Event 3 of Producer 2)
(raw event : Event 4 of Producer 1)
Algorithm 2
(reconstructed event : Reconstructed Event 3 of Producer 1)
Object Browser
http://hrivnac.home.cern.ch/hrivnac/Activities/Packages/ObjectBrowser
Top Level
Bus
_items
_producers
TestProducer
TestProducer
TestAlgorithm
TestAlgorithm
_consumers
_controllers
Algorithm 1
Properties
Value
fields
methods show
methods call
statics
protected
inherited
Upd...
Dump
Exit

```
Bus: Balance status:  reconstructed event:2 raw event:4
Bus: Speeding up raw event
AlgorithmImpl: New SLEEP = 1.5E-323
AlgorithmImpl: New SLEEP = 1.5E-323
ProducerImpl: New SLEEP = 1.5E-323
ProducerImpl: New SLEEP = 1.5E-323
Bus: Balance status:  reconstructed event:2 raw event:4
Bus: Speeding up raw event
AlgorithmImpl: New SLEEP = 1.5E-323
AlgorithmImpl: New SLEEP = 1.5E-323
ProducerImpl: New SLEEP = 1.5E-323
ProducerImpl: New SLEEP = 1.5E-323
Bus: Balance status:  reconstructed event:2 raw event:4
Bus: Speeding up raw event
AlgorithmImpl: New SLEEP = 1.5E-323
AlgorithmImpl: New SLEEP = 1.5E-323
ProducerImpl: New SLEEP = 1.5E-323
ProducerImpl: New SLEEP = 1.5E-323
Bus: Balance status:  reconstructed event:2 raw event:4
```

```
Swarm 1.1.0 [17/Feb/2012 at 15:12:31 CET]
BeanShell
2.0b2 - by Pat Niemeyer (pat@pat.net)
bsh %
```

```
raw event
reconstructed event
org.apache.log4j.Logger@3185768f
1.911855335635756E-98
1000.0
```

Object Browser

Global Operations

Command Line
- ➢full Java available

Dynamical Graphical view of
- ➢Producers/Consumers/Algorithms
- ➢BusItems
- ➢calls

The International Conference on Computing in High Energy and Nuclear Physics
New York, 2012