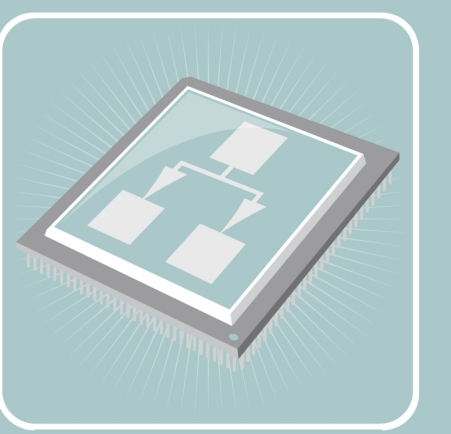


Parallel Code Generation in the Cloud

Team Convecs – Hugues EVRARD – Hugues.Evrard@inria.fr

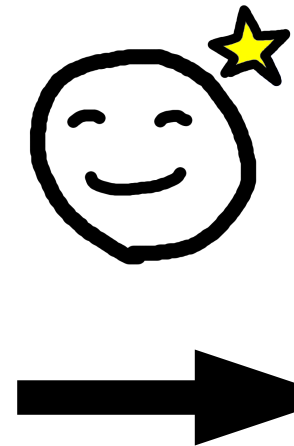
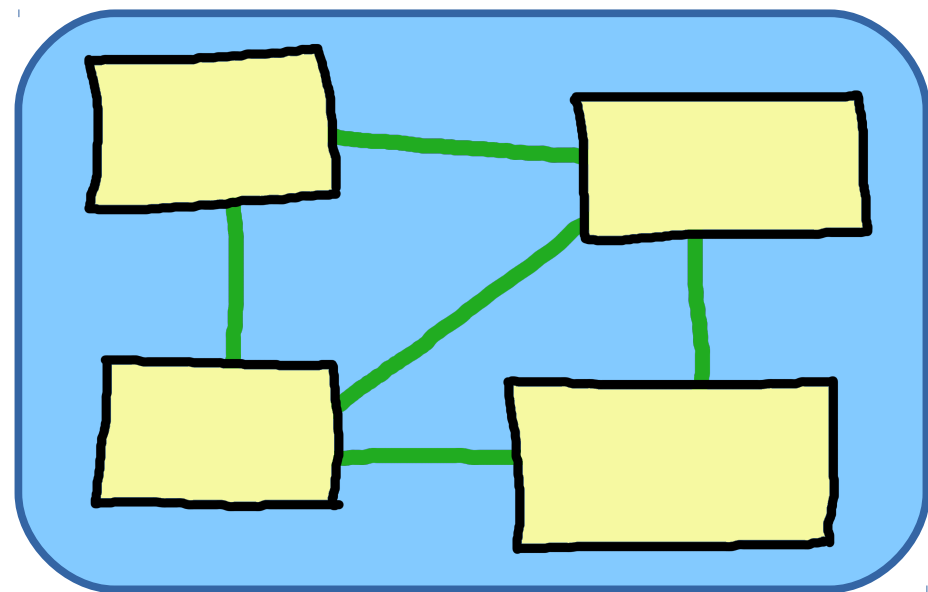


CONVECS

"Construction de Systèmes Concurrents Vérifiés"

LNT Formal Model of Asynchronous Concurrent Processes

```
run in parallel
  process_1
  process_2
  process_3
  ...
end parallel
```



Project OpenCloudware



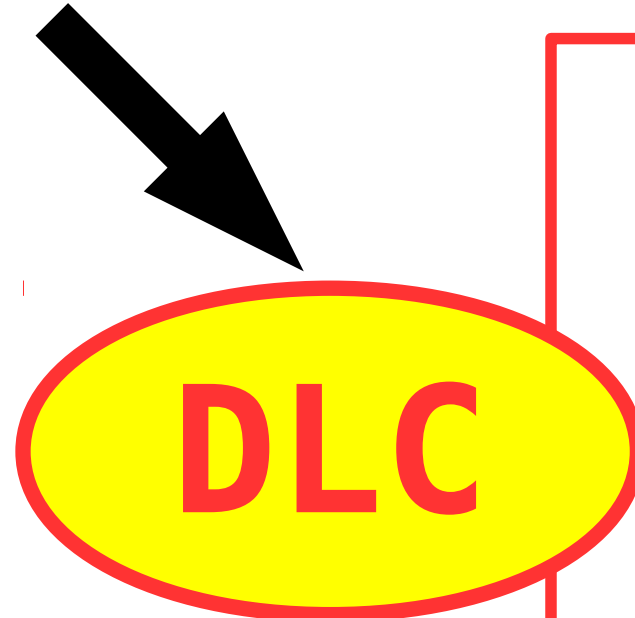
Formal verification with CADP



- 20+ years of research
- 50 tools: Model Checking, Simulation, Performance Evaluation...

Hand Implementation

- Time consuming
- Complex distributed programming



Distributed LNT Compiler (2)

- ◆ Automatic distributed implementation generation: C, POSIX sockets
- ◆ Process synchronization & communication by **multiway rendezvous** with **data exchange**
- ◆ Interaction with other systems by user-defined C *hook functions*

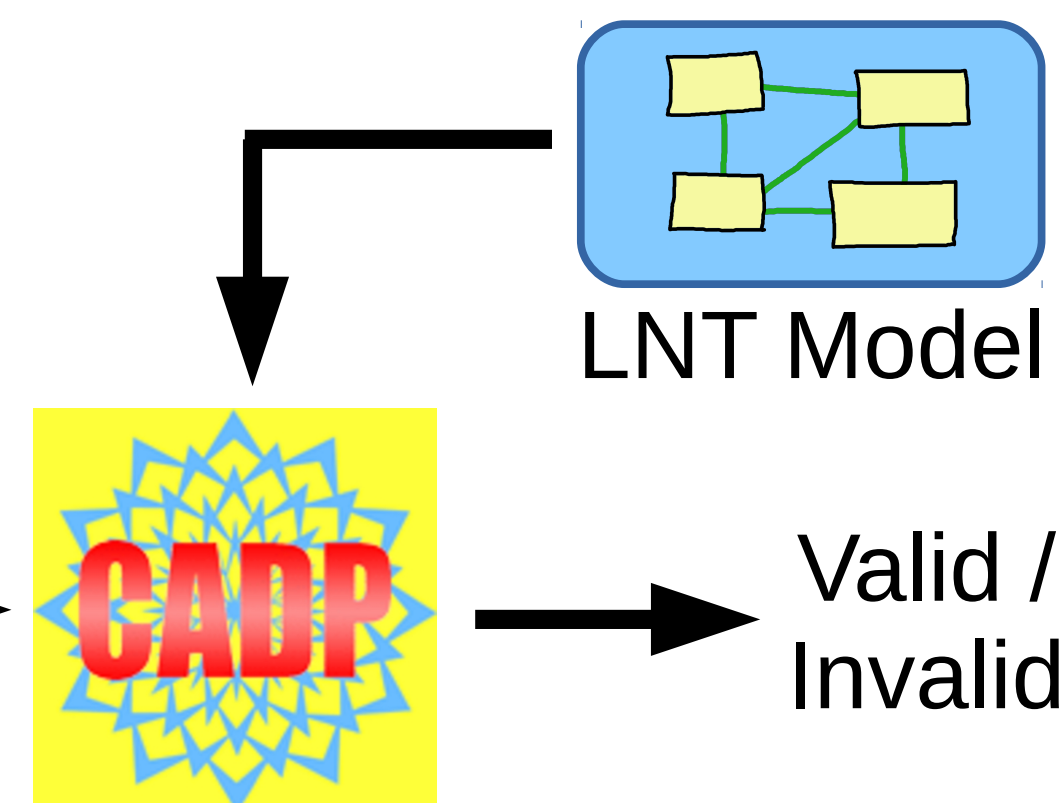


Distributed Environment

Grid'5000

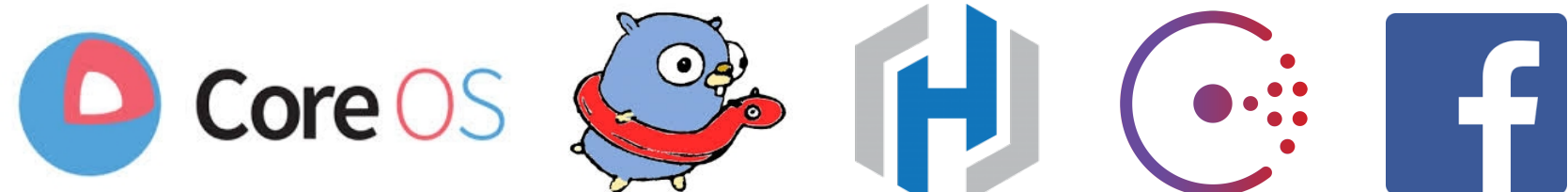
Correctness

- Formal verification of synchronization protocol (1)
- Trace inclusion verification (ongoing work):
 - After execution
 - At runtime

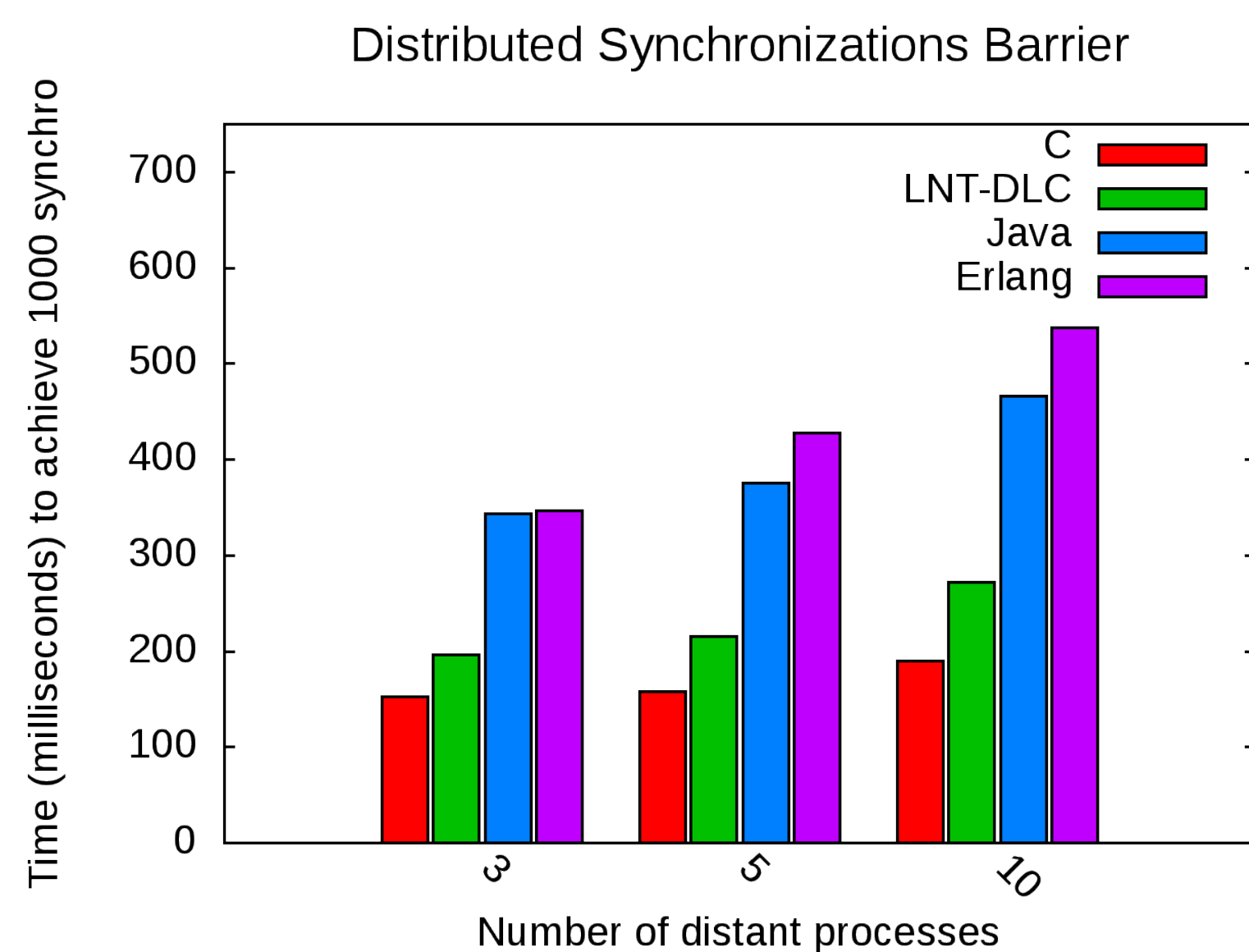


Case Study (ongoing work): Raft Consensus Algorithm

- Fault tolerant log replication (Paxos)
- Building block of reliable Cloud services
- Already used by : Facebook, CoreOS, Hashicorp, ...
- Evaluation: fault tolerant key-value store
 - DLC: ~500 lines of LNT
 - Hashicorp Consul: ~4000 lines of Go
 - 1000 writes: DLC 5 sec, Consul 0,5 sec
 - Consul "batches" requests



Multiway Rendezvous Performance Evaluation



Laboratoire d'Informatique de Grenoble

(1) Hugues Evrard, Frédéric Lang: *Formal Verification of Distributed Branching Multiway Synchronization Protocols*, FORTE'13, <http://hal.inria.fr/hal-00818788>

(2) Hugues Evrard, Frédéric Lang: *Automatic Distributed Code Generation from Formal Models of Asynchronous Concurrent Processes*, PDP2015 (4PAD), accepted, to be published

