Perspectives in Performance Evaluation of Large ATM Networks

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Laboratoire LIP6

Goals

Performance Evaluation

- Analytical methods are too limited
- Simulations are very time-consuming

Reduce the simulation time

- Parallel and Distributed Simulations

ATM Network Models

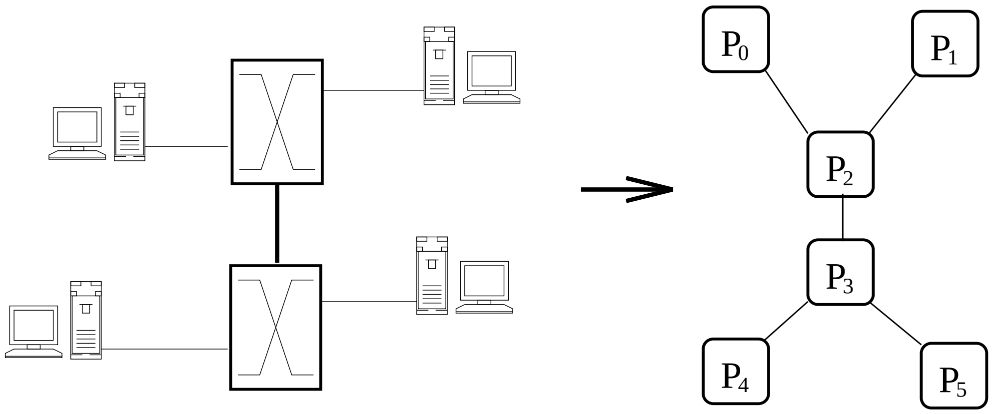
- Hot problem
- Cooperation with the Dret

Our contribution

- Distributed Simulator for ATM Models
- Simulation of Large and Complex Models

Parallel Simulation and The Process Synchronization Problem

Spatial partitioning and Logical Process (LP)



Distribution of event lists and virtual clocks.

⬇

Causality constraints and time errors.

⬇

A synchronization algorithm is needed to respect causality.

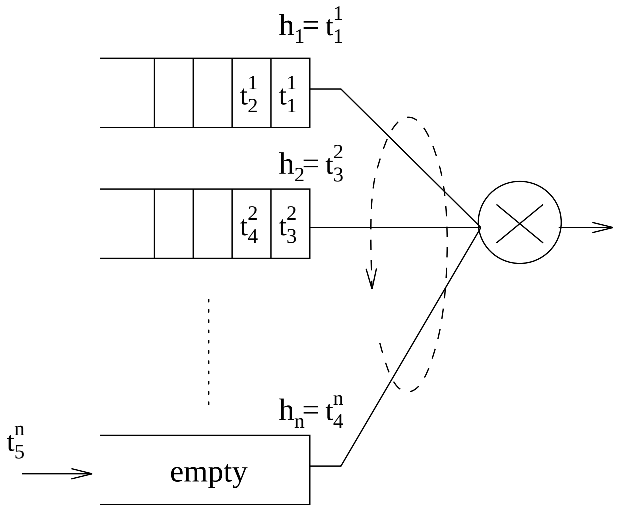
⬇

These synchronization mechanisms fall in two categories: **conservative** and **optimistic**.

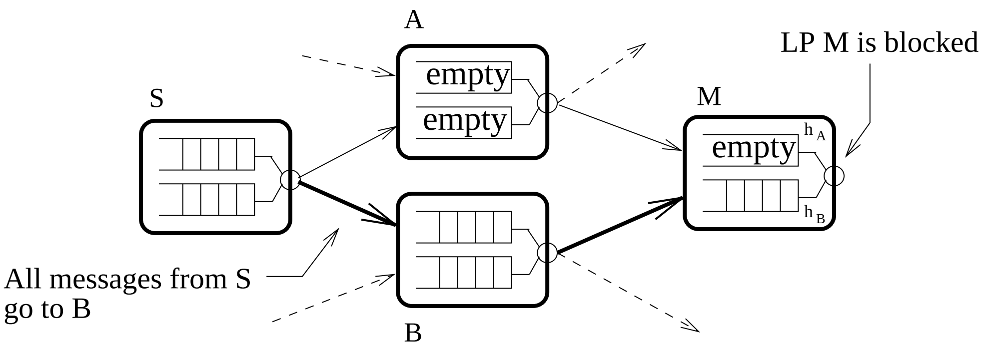
Conservative Approaches

Conservative algorithms (Chandy-Misra-Bryant) avoid all cases of time errors by blocking LPs.

The basic conservative algorithm

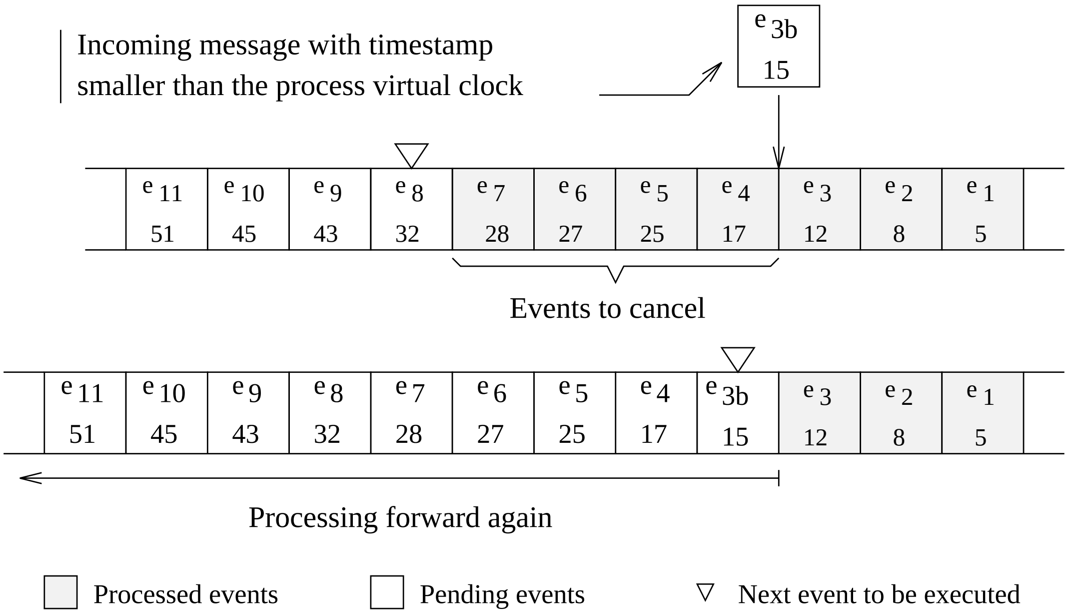


Deadlock → null-messages and lookahead



Optimistic Approaches

Optimistic algorithms (Time Warp) implement a rollback mechanism.



Need of periodic state saving and anti-messages to:

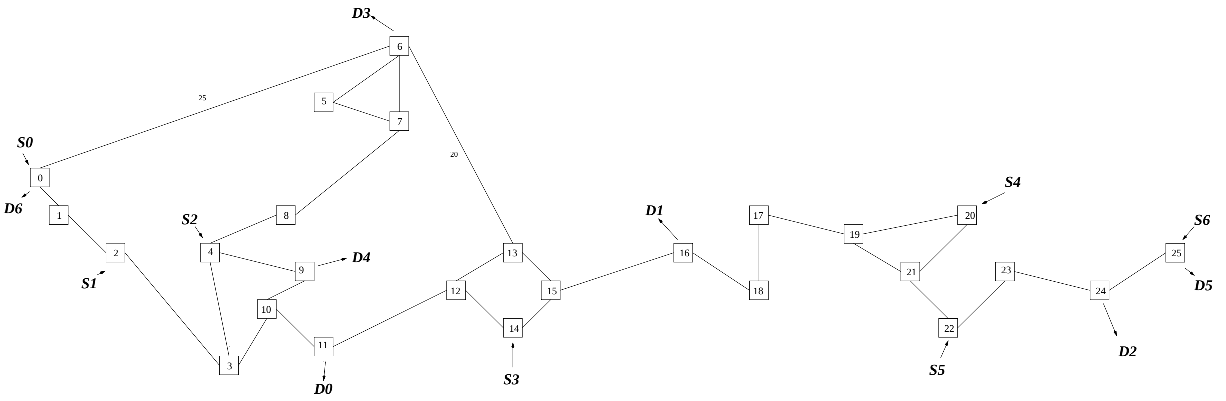
- Restore the process state,
- Send anti-messages to other processes,
- Re-execute events in the right order.

Network model

Complex network with routing algorithm

Simulation at the cell level

Connection management and VPI/VCI commutation



Network model with 26 switches

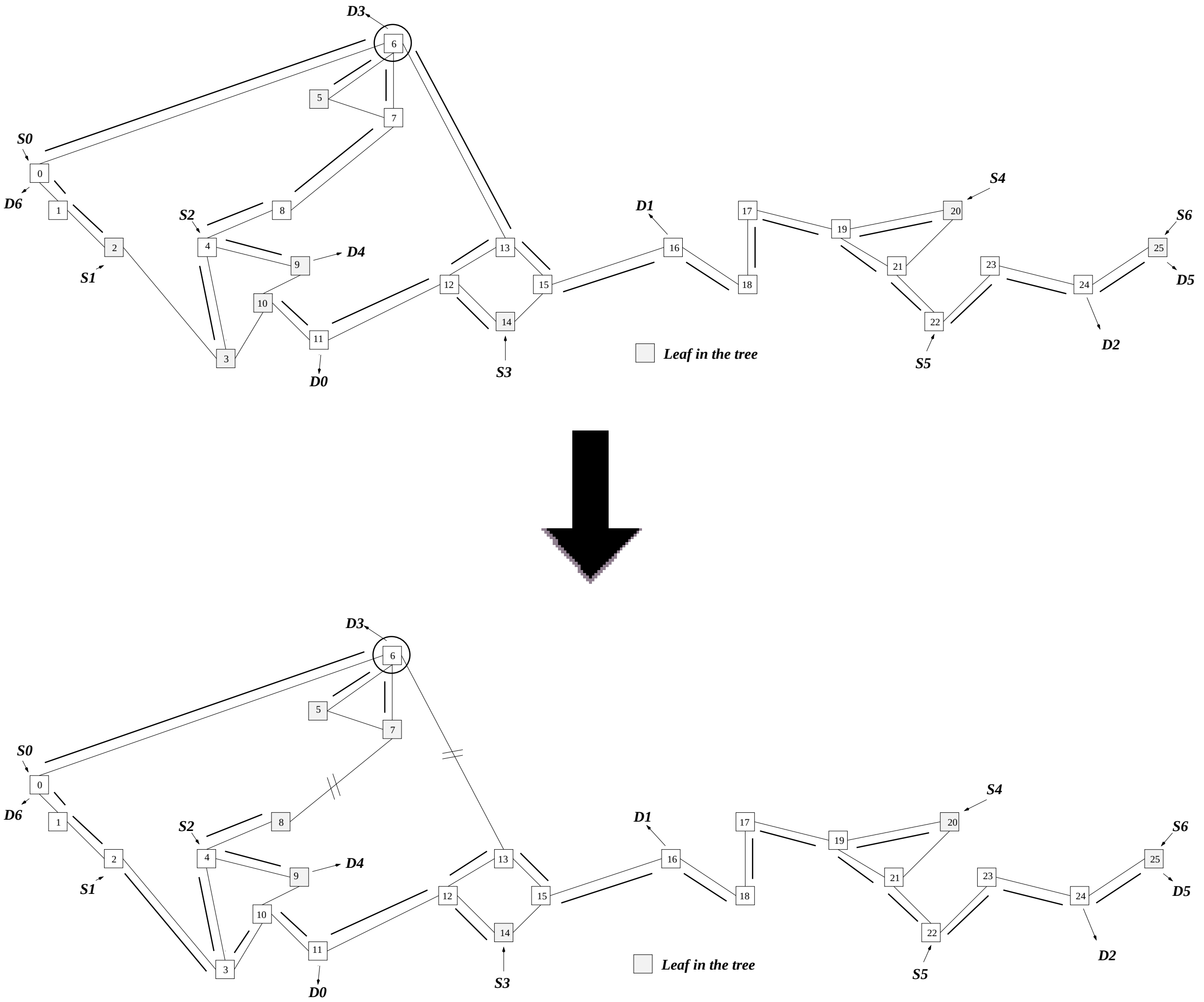
- ☞ Loops
- ☞ Load imbalance

Simulation of a Routing Algorithm

The Jaffe and Moss algorithm

Vector-Distance Protocol

Construction and Update of Routing Tables



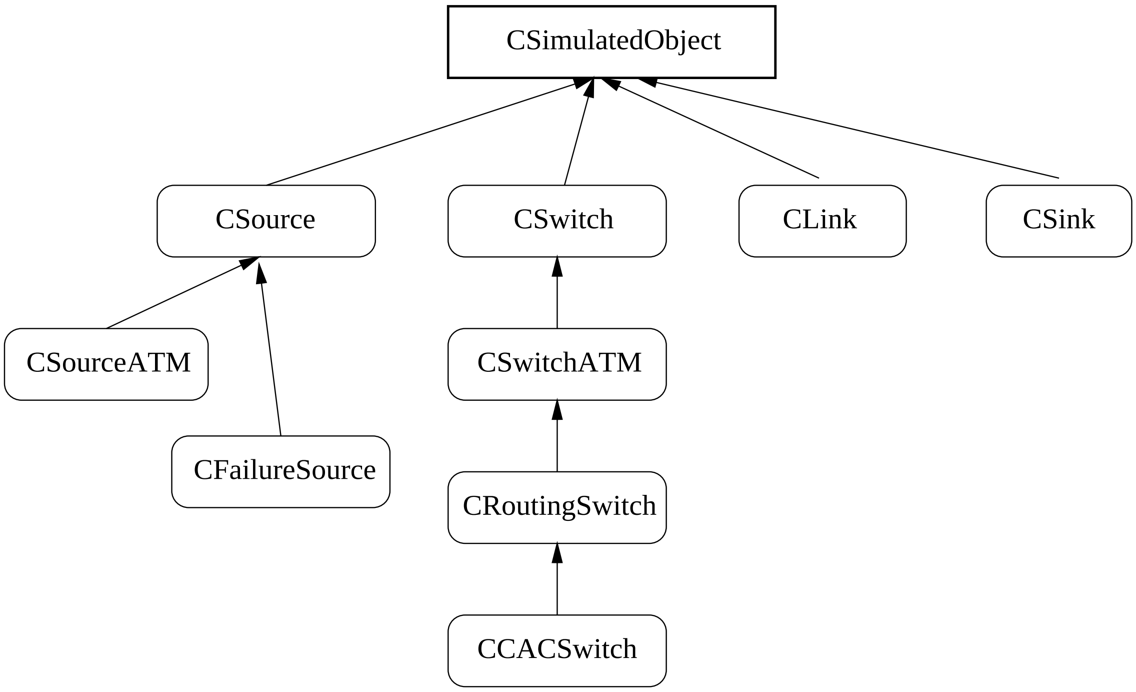
The Distributed Simulator

Unified Framework for Sequential and Distributed Simulations

Object-Oriented Design, Written in C++

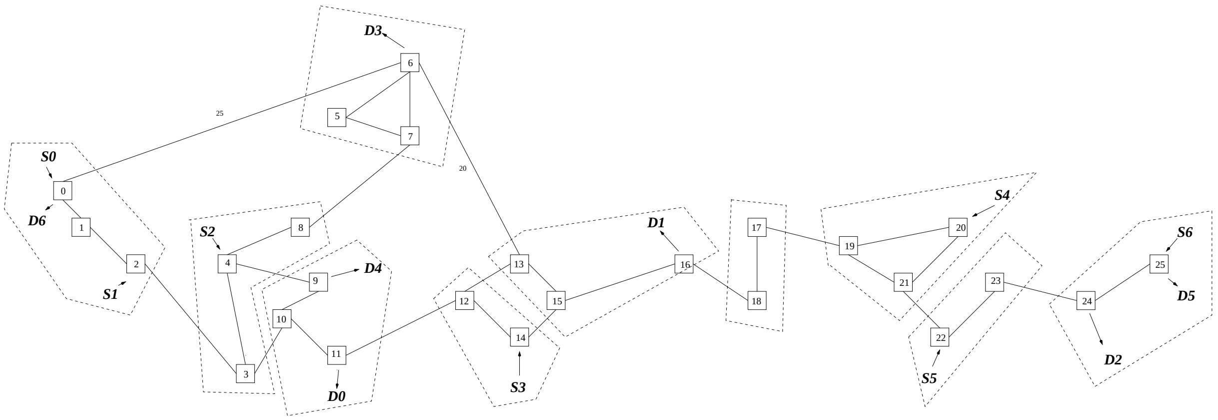
Conservative Synchronization

Tested on Sun Workstation, Intel Pentium, CM-5, Cray T3E

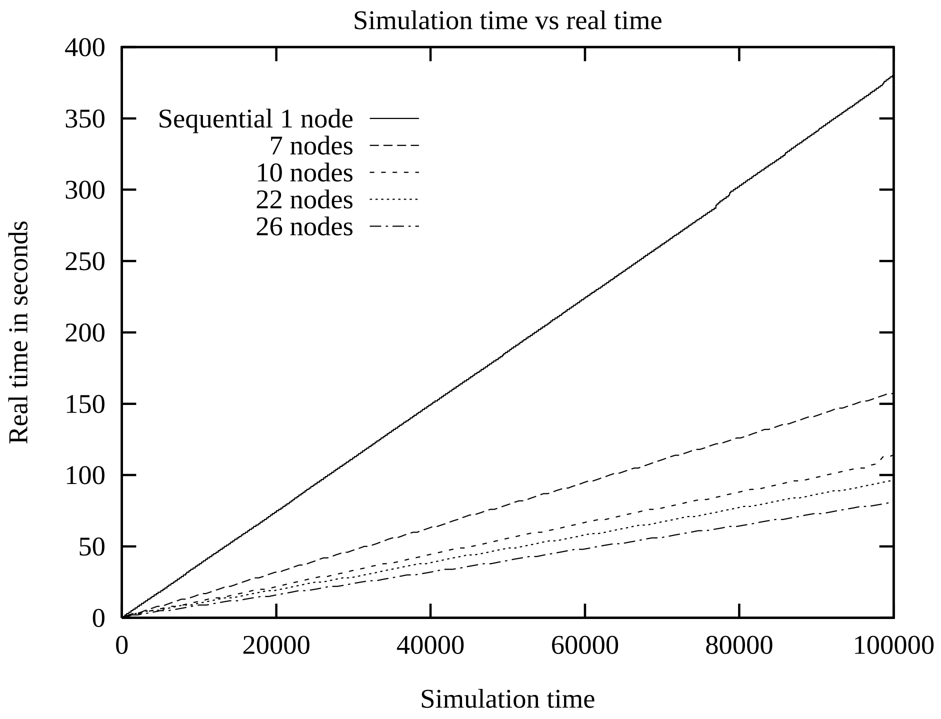


Simulation time

7, 10, 22 and 26 processor mapping



10 processor mapping



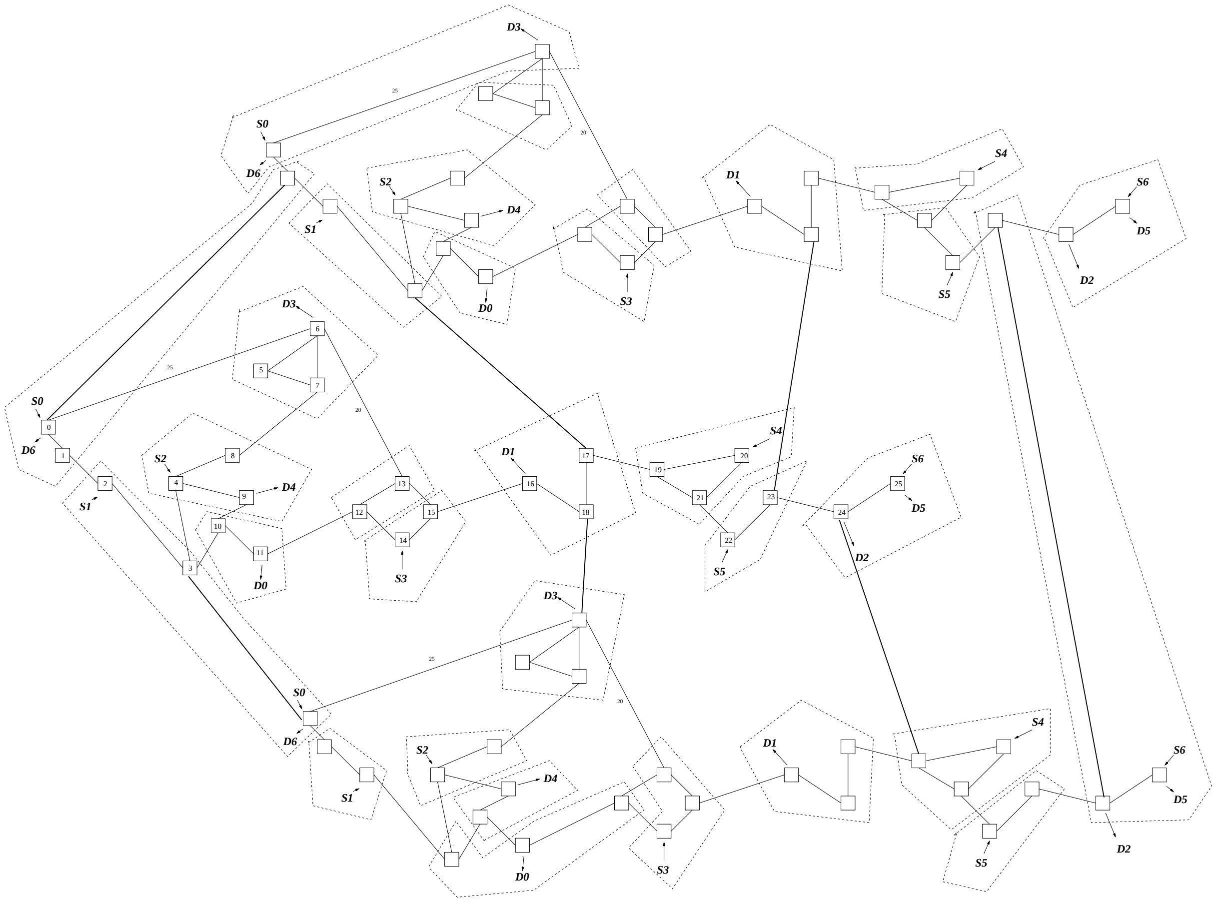
Speedup

Speedup and Efficiency

nproc	*real time*		*speedup*		*efficiency*	
	CM-5	T3E	CM-5	T3E	CM-5	T3E
1	380	33	–	–	1.0	1.00
7	158	14	2.41	2.36	0.34	0.33
10	115	14	3.30	2.36	0.33	0.23
22	97	12	3.92	2.75	0.18	0.125
26	84	10	4.52	3.3	0.26	0.126

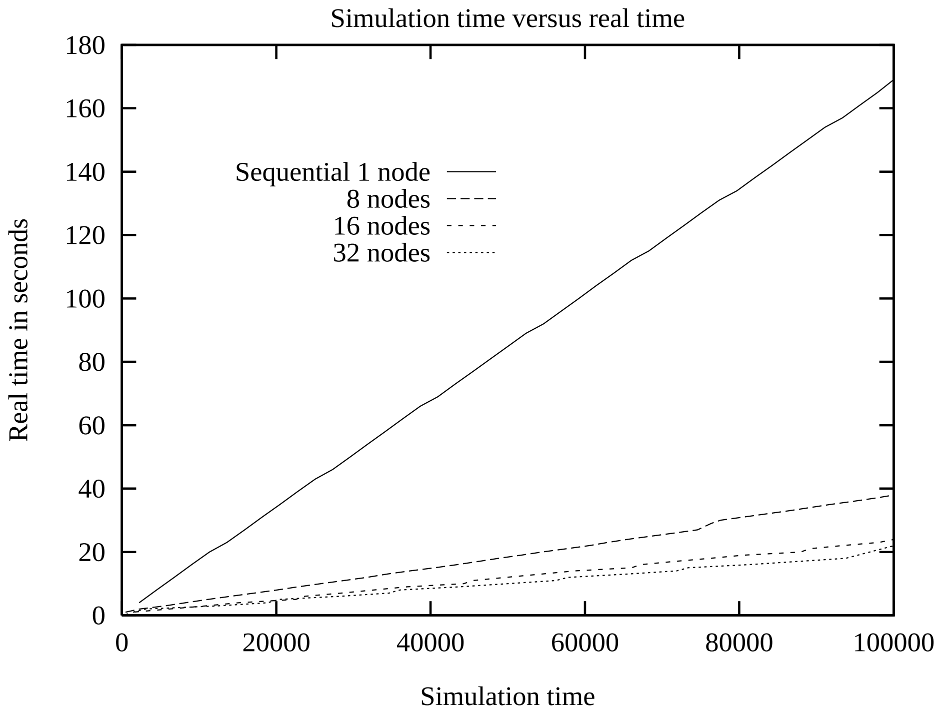
Increasing the network size

Model with 78 switches



32 processor mapping.

Speedup



nproc	*Real time*	*speedup*	*efficiency*
1	169	–	1.0
8	38	4.44	0.55
16	24	7.04	0.44
32	22	7.68	0.24

Speedup and Efficiency

Conclusion and Perspectives

- ✔ Distributed simulation techniques can successfully be applied to simulate large and complex models.

- ✔ A speedup of 7.68 can be achieved with our distributed simulator.

- ✘ Implementation of more models.

- ✘ Load balancing features.