How Can We Study Large and Complex Systems

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31TH SIMULATION SYMPOSIUM
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Performance Evaluation

How to handle large systems?

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

Reduce the simulation time

- Faster sequential computer,
- Hybrid simulation,
- Parallel architectures.

Parallel and Distributed Simulation

- On parallel computers, networks of workstation,
- Focus mainly on synchronization problems.

Parallel Simulation Today

A large variety of conservative and optimistic protocols

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Performances depend on many factors

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No general protocols for a large variety of applications

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Very few demonstrations that parallel simulation can be used on realistic models

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Strange tool and too difficult to use

Ongoing projects

- Telesim project at the U. of Calgary
  - Traffic sources, High-speed Networks
- Research at SimLab at KTH
  - Mobile Telecommunication Systems
- Domains project at UCLA
  - Heterogeneous Wireless Mobile Networks
- S3 project at Georgia Tech
  - Very large-scale telecommunication networks
- CSAM simulator at the LIP6
  - Large ATM networks

Rationales for CSAM

Focus on communication network models

⬇

Provide high transparency

⬇

Facilitate model developments

and

Hide the complexity of parallel simulation techniques

⬇

Conservative approach

Lookahead of link's propagation delay

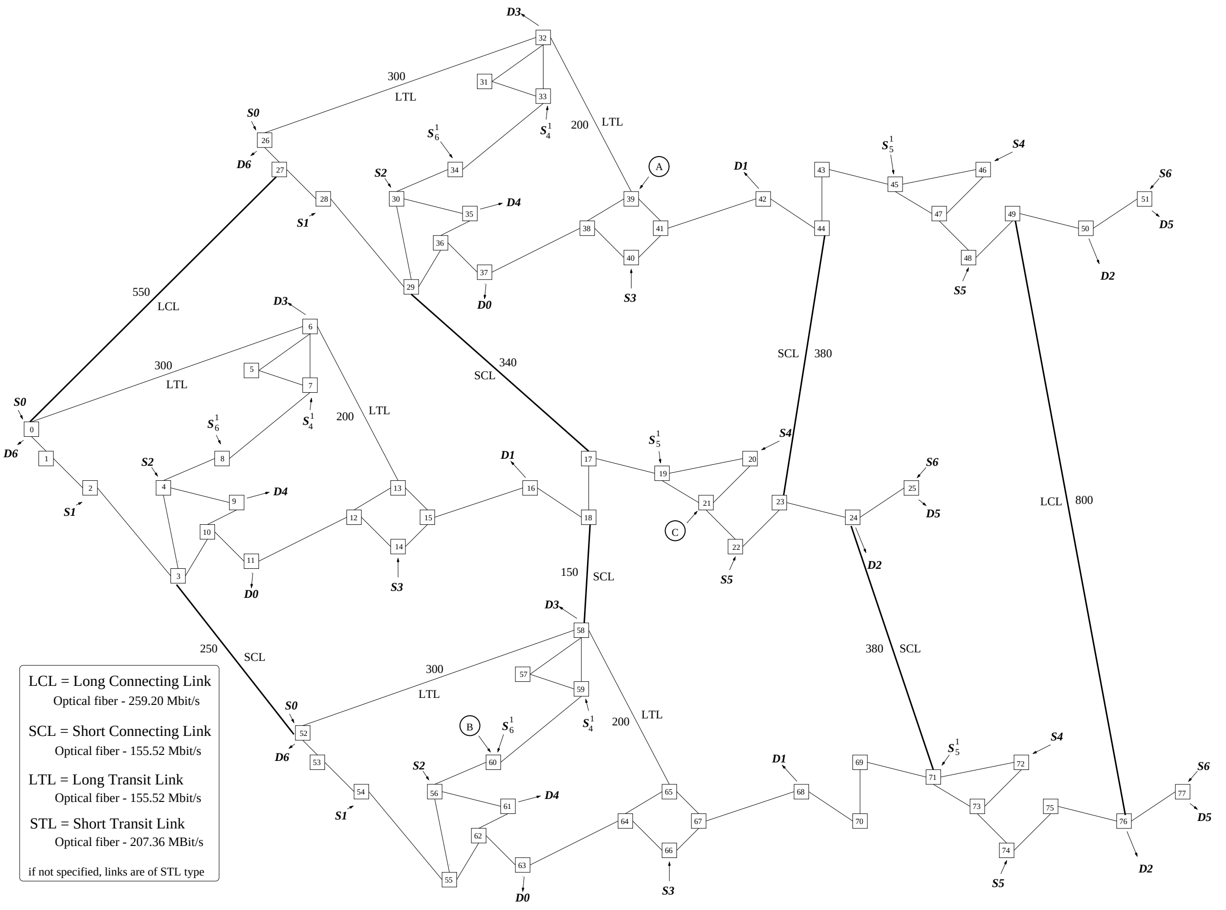
Development in C++

The ATM network model

78-SWITCH NETWORK WITH ROUTING FACILITIES

ROUTING ALGORITHM WITH DYNAMIC LINK COSTS

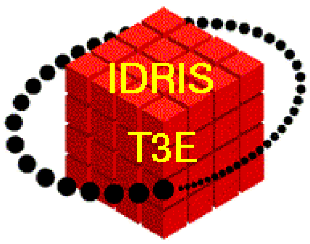
CONNECTION MANAGEMENT AND ADMISSION CONTROL



Why is it so difficult ?

- Load imbalance between links
  - a lot of null-messages have to be sent.
- Bottlenecks in the simulation model
  - some processors can be overloaded.
- Complex load-balance patterns
  - partitioning and load-balancing are difficult.
- Very small granularity
  - high level of message synchronization.

Experimentations



Cray T3E with 256 processors

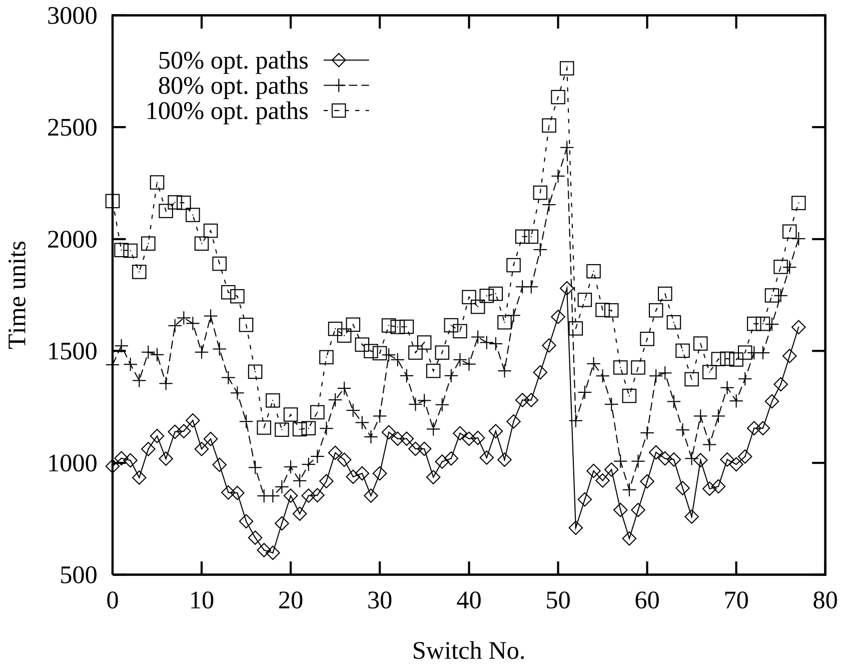
SHMEM library

We simulate 200,000 time units

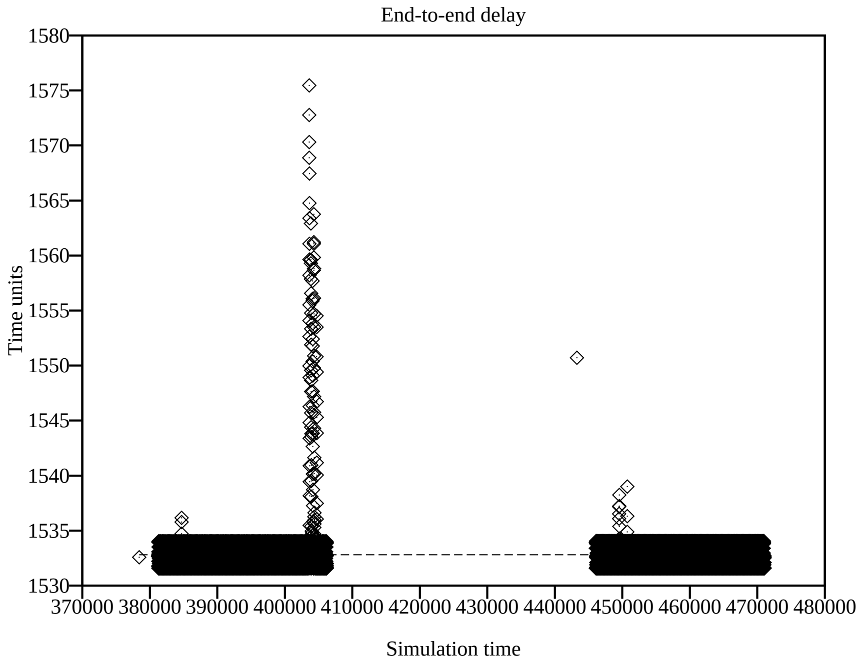
that represent 0.31s of the real system

18 million of events simulated

Performance of the model

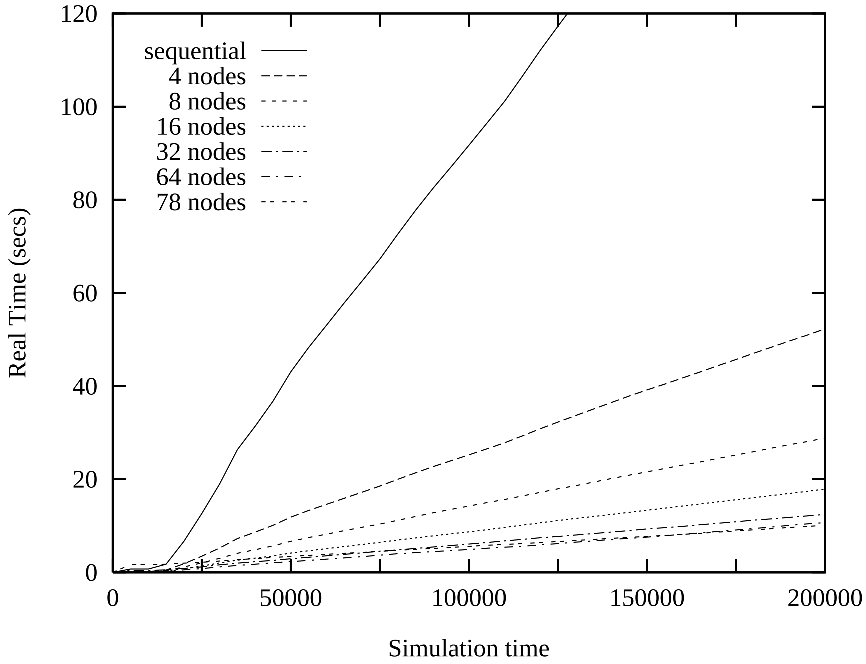


Time to find optimal paths



End-to-end delays

Performance of the Simulator



nproc	*ex. time*	*speedup*	*efficiency*
1	189	–	1.0
4	52	3.63	**0.91**
8	29	6.52	0.81
16	18	10.5	0.66
32	12	15.75	0.49
64	11	17.18	0.26
78	11	17.18	0.22

Conclusions

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

- ✓ Focusing on a class of applications can produce very integrated tools. A speedup of 17.18 has be achieved without any distributed simulation knowledge for the user.

- ✗ Load balancing features.

- ✗ Experimentations on high-speed LANs.