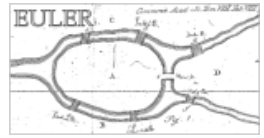

Simulating Routing Models on Large-Scale Topologies

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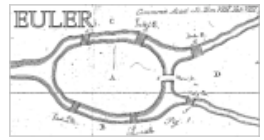
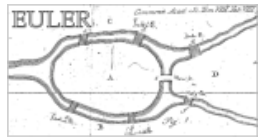
Future Internet Assembly, EULER Workshop, Aalborg, Denmark

Outline



- Objectives
- DRMSim architecture
- Resources
- Demonstration

Bottom-line



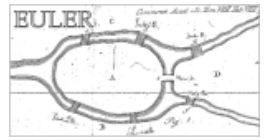
Why DRMSim (Dynamic Routing Model Simulator)?

- To evaluate performances and determine dynamic properties of routing models on large-scale topologies (>10k nodes);
- To compare them with current Internet routing system inter-domain routing model (BGP).

Dimensions:

- General-purpose vs. Specialized simulators (e.g. SimBGP);
  - Optimized (in terms, e.g., of data structures and procedures) to execute BGP at the microscopic level on topologies comprising order of 1k nodes;
  - Can not be easily extended to other routing protocol models.
- Macroscopic simulation vs. Microscopic simulation.

Routing/forwarding model



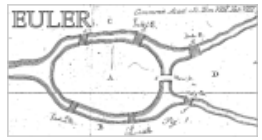
A common source of confusion lies in the difference between routing model simulation and forwarding model simulation.

Definitions:

- routing model: exchange of routing information messages for computation and/or selection of routes.
- forwarding model:
  - Refers to the processing of incoming traffic messages.
  - Selection of an outgoing interface using the message's destination address.

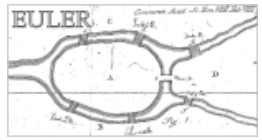
We are only focusing on the Routing Model.

Performance



- Stretch:
  - multiplicative: $\frac{|path(u \rightarrow v)|}{d(u,v)}$, with $u, v \in G$
  - additive: $|path(u \rightarrow v)| - d(u,v)$ with $u, v \in G$
- Memory space consumption = number of bits required to store locally RT entries (RT size);
- Communication cost = number of routing update messages exchanged between routers to converge upon topology change;
- Computational complexity (time and resources) to compute RT entries.

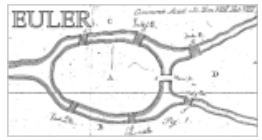
DRMSim Features



DRMSim features:

- large scale simulation;
- internet-like and other topology generators;
- performance measures (stretch, number of messages, etc);
- API for extensible routing algorithm;
- policy model;
- uniform scenario.

DRMSim Features (2)



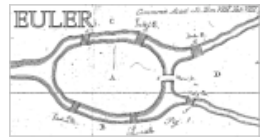
DRMSim modularity:

- new topology generators, routing models and metrics must be easily added by users;

DRMSim usability:

- DRMSim must be user-friendly. Setting, starting a simulation must be an easy task.

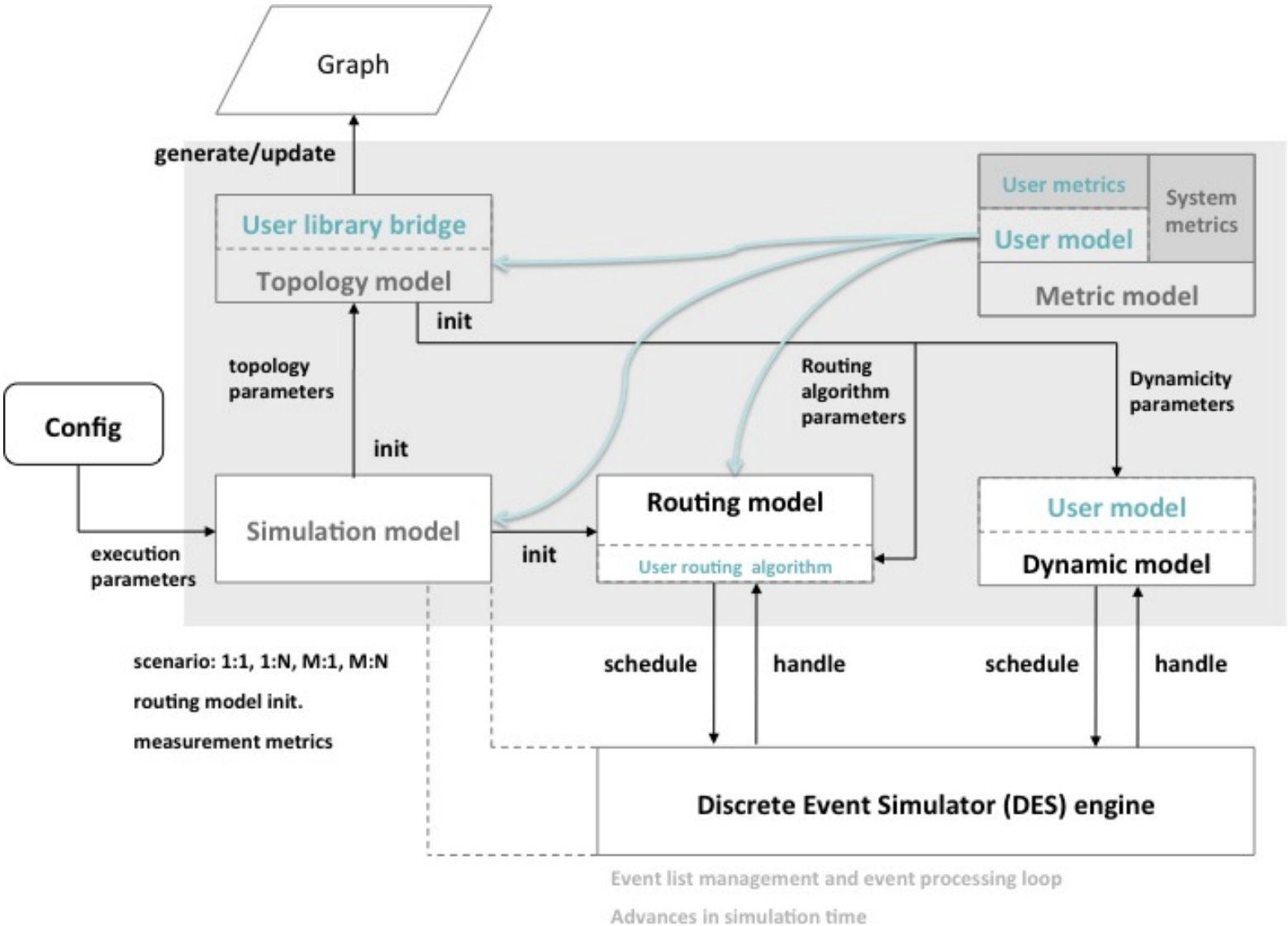
DRMSim



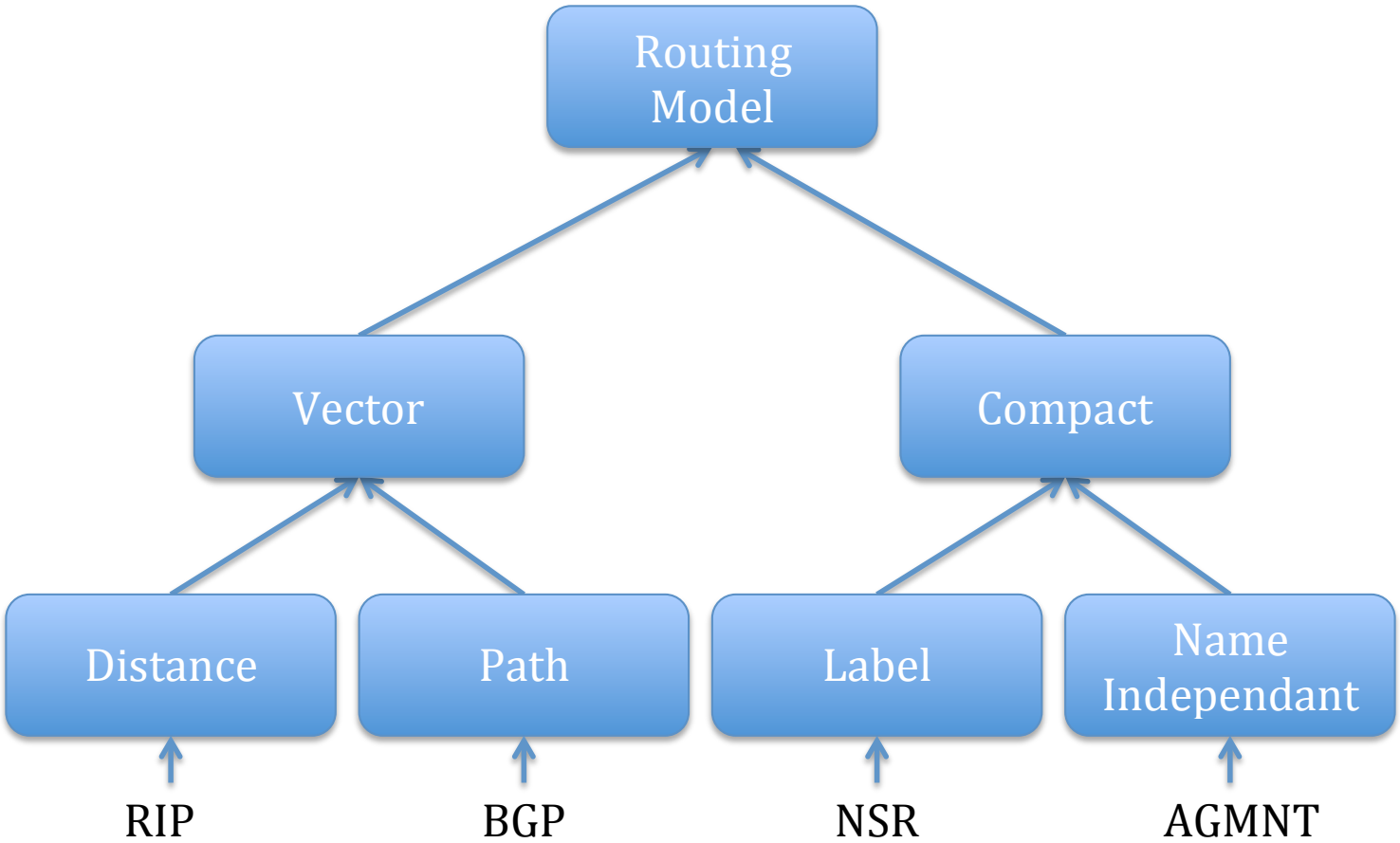
DRMSim is composed of:

- a discrete event simulator engine (Mascsim);
- a topology model;
- a topology dynamicity model;
- a metric model;
- routing models.

DRMSim architecture

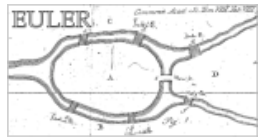


Routing models computation



Models implemented: RIP, BGP, NSR.
Model under implementation: AGMNT.

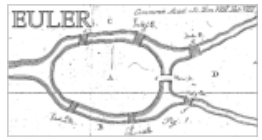
Routing models communication



A routing model also specifies the information exchanged between routers (routing update messages) and their communication mode between routers:

- routing information communication model is instantiated for each router at topology initialization (depending on routing model);
- when a routing update message is received by a router, the routing algorithm is applied.

Metric model



Topology dynamics:

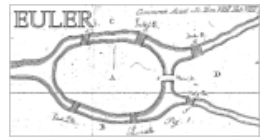
- number of router failures;
- number of link failures.

Routing model performance:

- stretch: multiplicative, additive;
- memory space consumption, routing entries;
- communication cost.

Metrics can be computed globally for the whole topology and for each router. They can be restricted to a set of selected routers.

Traffic message transmission

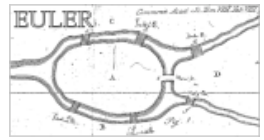


Traffic messages transmission simulation allows to evaluate compact routing model performance. Traffic messages are composed of:

- a header itself composed of:
  - a source;
  - destinations;
  - partial routing information.
- the incoming link;
- the incoming router.

Once a traffic message arrived at a router, the routing procedure to derive the next hop is applied. Then, the header is updated and the message forwarded to the next hop.

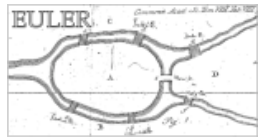
Simulation scenario



Scenario: modelizes the traffic messages communication:

k to k,	send traffic messages from k source to k destinations.
one to one,	sends a traffic message from a source to a destination;
all to all,	every router sends traffic messages to all other routers;
one to all,	one router sends traffic messages to all other routers;

Simulation scenario (2)



But scenario can be also model specific:

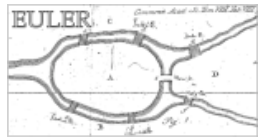
for BGP, runs until convergence, wait that no update event remains;

for NSR, tree computation;

And dynamic network:

- defines probability of link/router failure.

Topology model



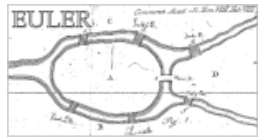
Topology model controls the network structure during the simulation. It relies on bridges linked to graph librairies:

- Grph;
- Dipergrafs;
- possibly others.

Allows to:

- Perform structural operations (addition/removal of nodes/links);
- Generate, Load or Save topologies.

Topology dynamicity model



Topology dynamics consider maintenance operations on the network infrastructure as well as router failures.

It is possible to define:

- which link/router to delete/restore;
- the probabilities of router/link failure/restoration;
- the time interval between which dynamicity events occur.

Where to get DRMSim

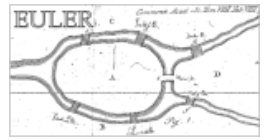
Gforge website: `https://gforge.inria.fr/projects/drmsim`
SVN repository: `https://scm.gforge.inria.fr/svn/drmsim`

DRMSim temporarly website: `http://drmsim.gforge.inria.fr`

EULER wiki:

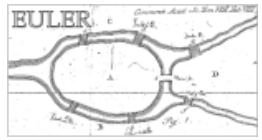
`Home` ≫ `PP` ≫ `WS` ≫ `WP 4` ≫ `T42` ≫ `Simulation Tools` ≫ `DRMSim`

Conclusion



- validation of implemented models;
- complete set of metrics;
- measurement on topology dynamic scenarios.

Questions



Thank you

Questions?