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Erwan Moréac, Johann Laurent, Pierre Bomel, André Rossi

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# A bit-accurate power estimation simulator for NoCs

Erwan Moréac, Johann Laurent, Pierre Bomel  
 Lab-STICC, Université de Bretagne Sud, Lorient, France  
 and André Rossi  
 LERIA, Université d'Angers, Angers, France



<http://www.lab-sticc.fr>



<http://www.info.univ-angers.fr/leria>



<http://www.cnrs.fr>

## Context

Complex many-cores and SoCs contain one (if not several) NoCs. NoC power consumption can represent a significant proportion (40%) of the overall power consumption.

## Power/energy challenges

Estimate NoC power consumption at system-level, and bit accurately, without the need for electrical simulations.

*"Is it possible to shorten the simulation and still get good estimations?"*

Design and test new coding strategies to reduce power consumption on links.

*"What is the energy impact at system-level?"*

*"Is a single coding strategy always the best fit?"*

*"What is a good set of coding strategies?"*

Design space exploration of coding strategies.

*"Is it realistic in terms of simulation time and precision?"*

## Main idea

Enhance Noxim simulator and modify it to add a crosstalk-aware link power model moving towards better power estimation.

➡ Noxim-XT

Use a SoC simulator to extract application traffics

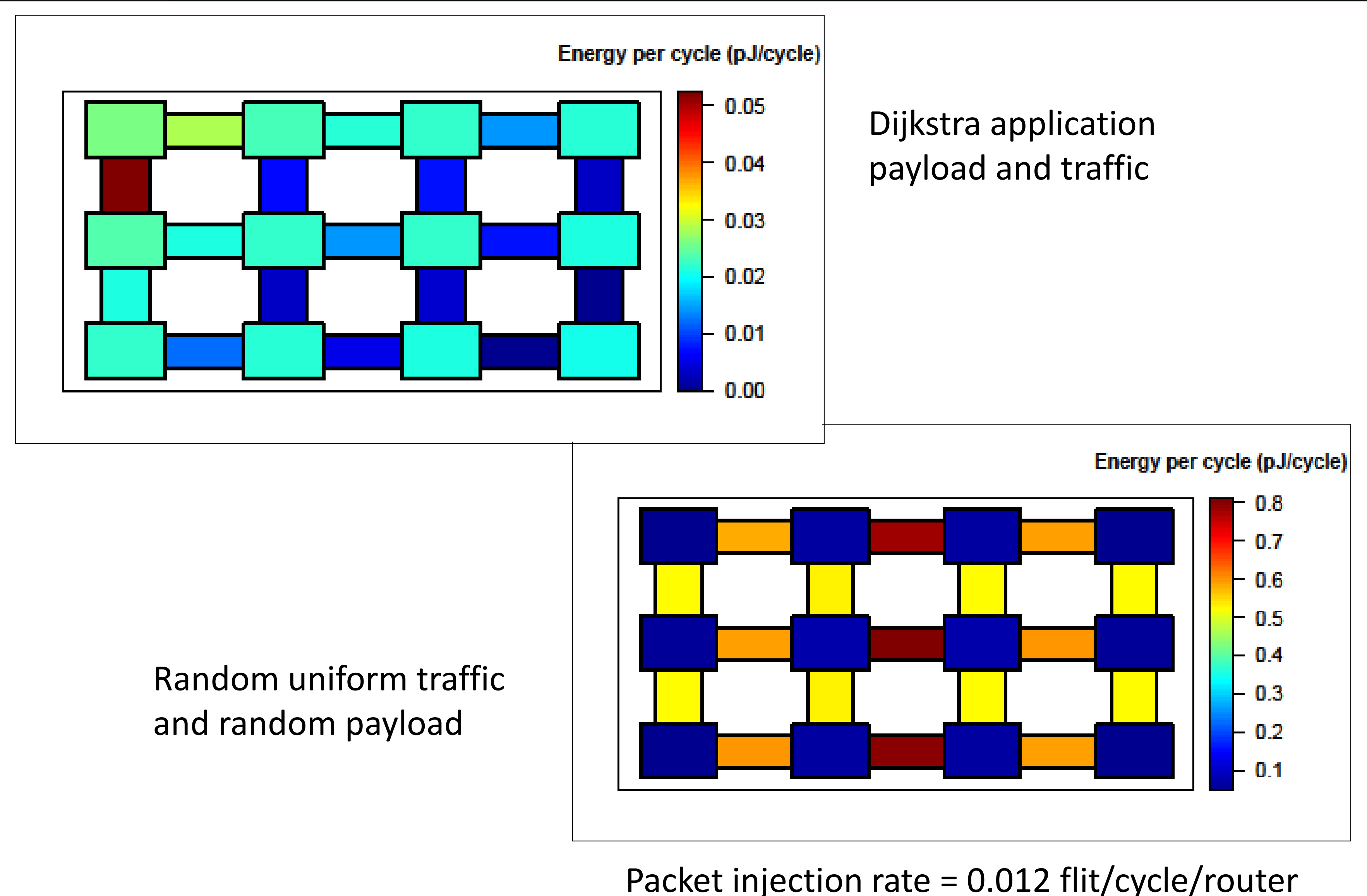
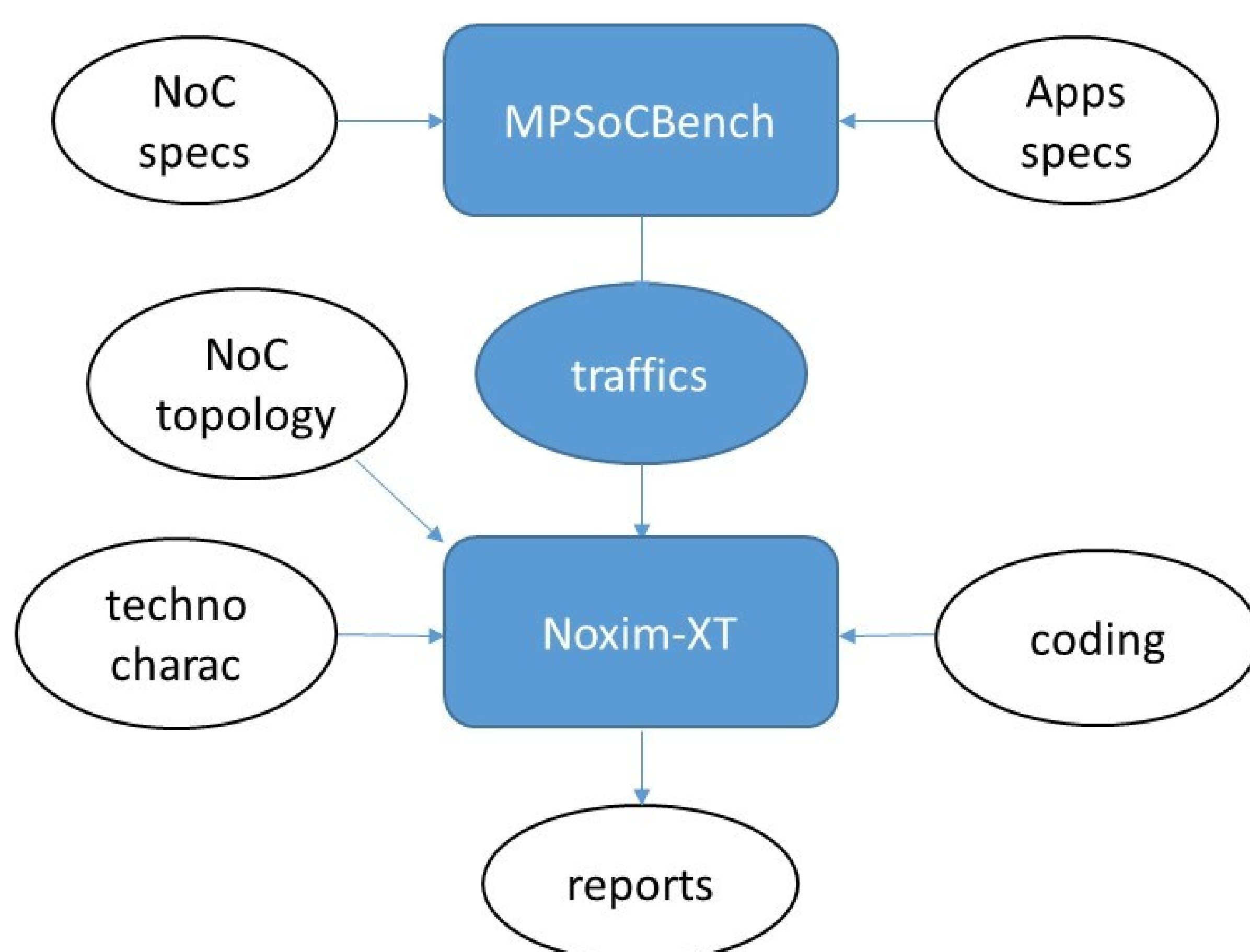
➡ MPSoCBench

Design new coding strategies, and optionally use NoC's feedback  
 - coding styles: parallel, parsimonious, temporal shielding, ...  
 - selection strategies relying on NoC status

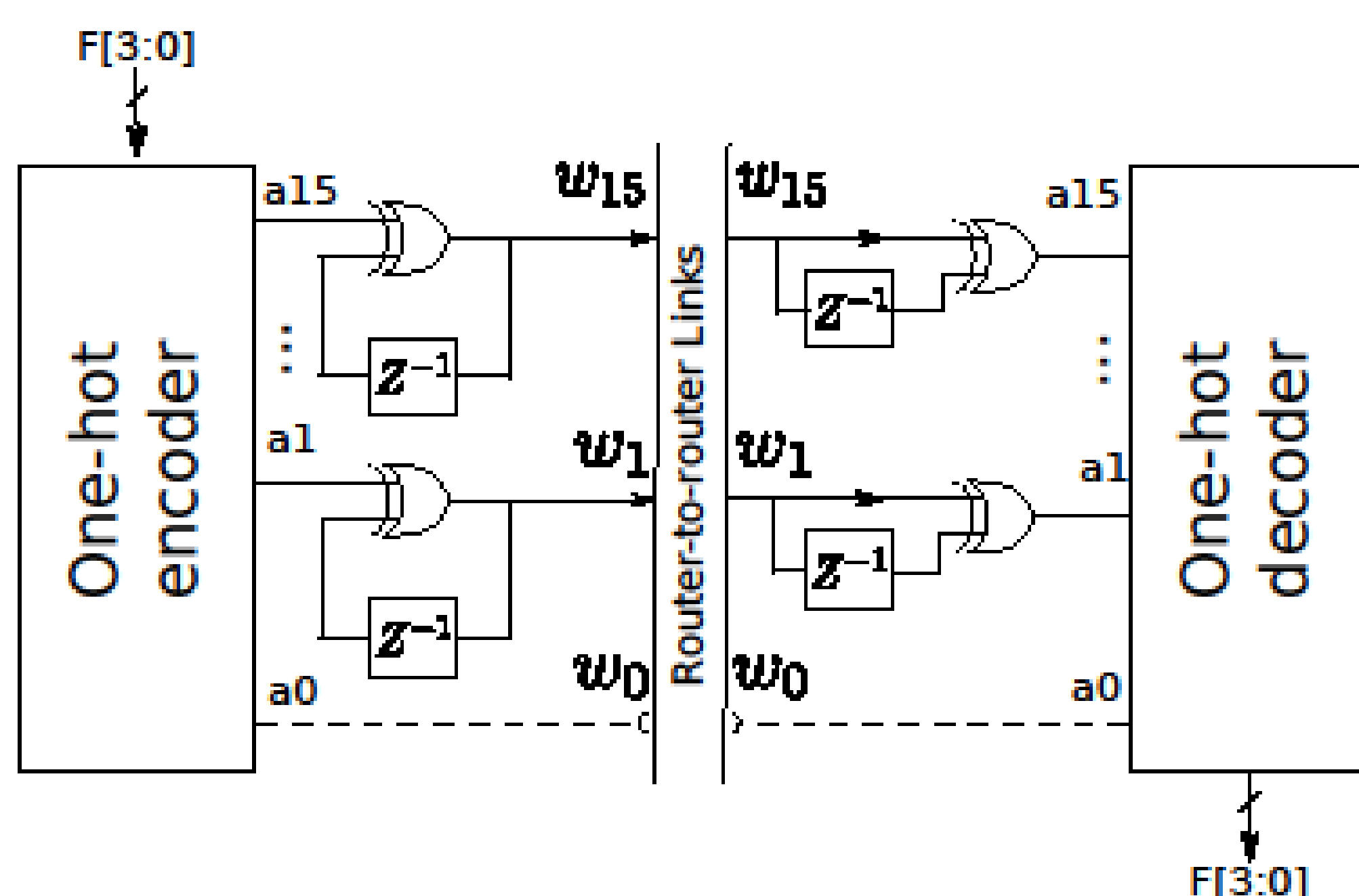
Simulate with Noxim-XT

- estimate and extract power consumption
- check that application behavior is correct
- test with various application traffics and with various codings

## Power consumption estimation tools flow



## Encoder architecture



- Designed to be as small as possible:
- eliminates cross transitions
  - reduces links activity
  - but increases the flit transmission time
- ⇒ Must be activated with parsimony

**Gains** Up to 35% of energy savings are possible for NoC

## Applicability conditions

Need to characterize, for a given technology, the energy cost of transitions along a link.

Coding strategies have different impacts on power consumption and bandwidth and some can significantly reduce the power consumption of the NoC

➡ "raw" (no change), parsimonious, temporal shielding

(we are open to the design and test of other coding strategies)

Depending on the NoC's load, these new strategies can be applied, or not.

Hence, a detection mechanism is necessary to enable them dynamically.

## Distance to the optimum and perspectives

Statistical study with video and random data has proven that our best shielding solutions (although very simple to implement) are as close as 95% to the optimal shielding.

With the help of Dijkstra's shortest path applied to a power consumption graph, automatically build, we have observed that some optimal solutions need two successive shields, instead of one.