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A bit-accurate power estimation simulator for NoCs

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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

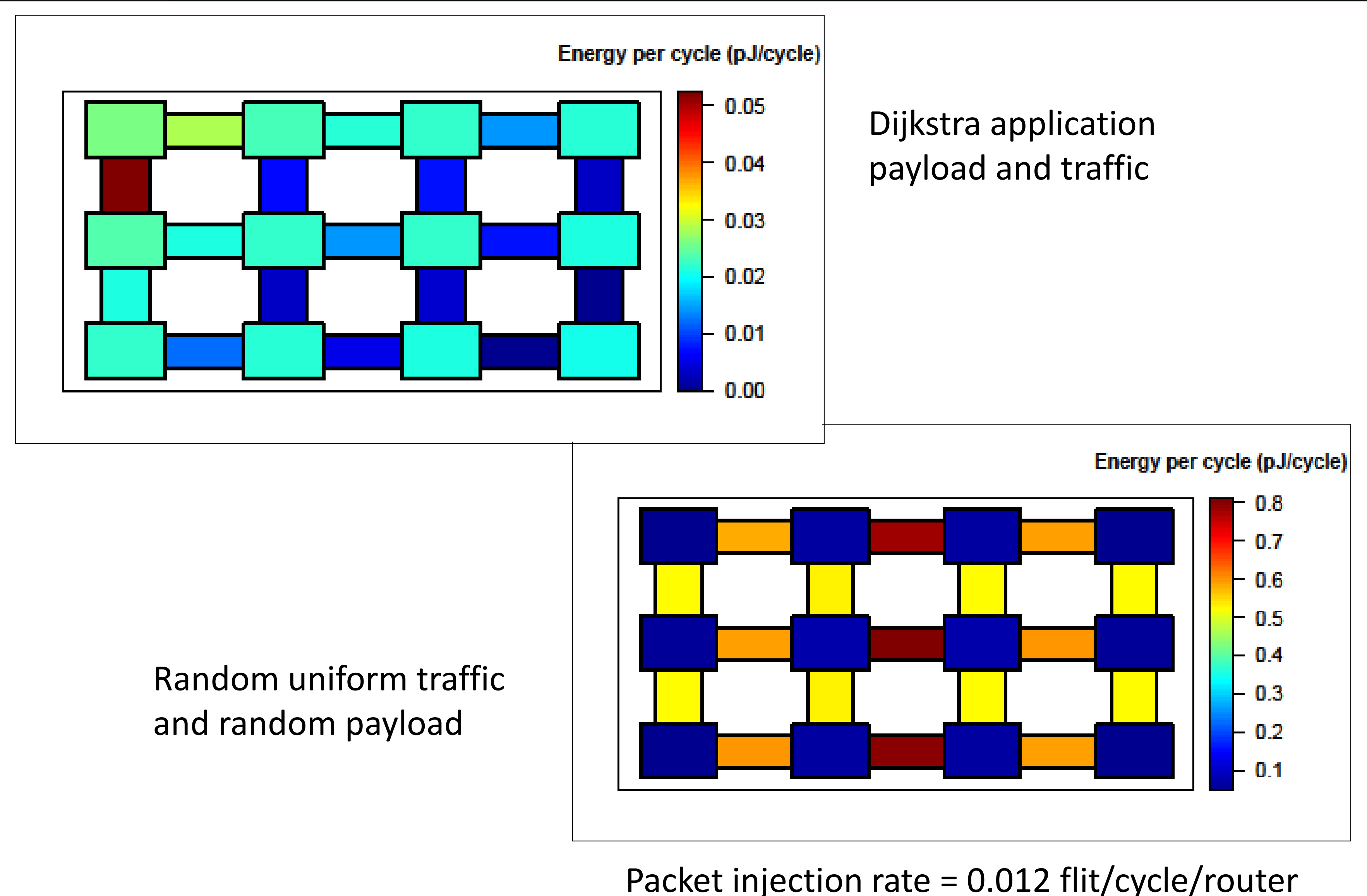
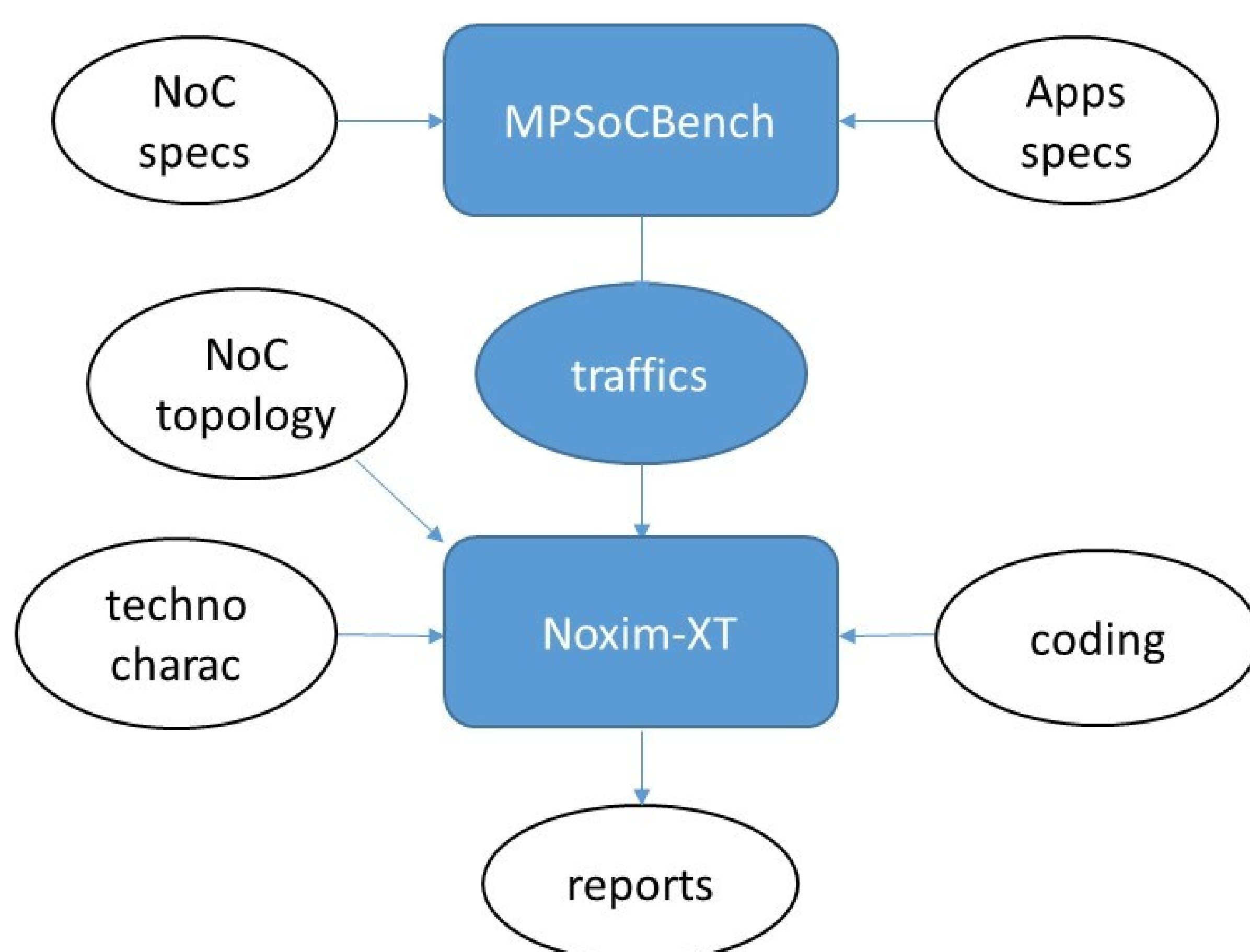
➡ MPSoCBench

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

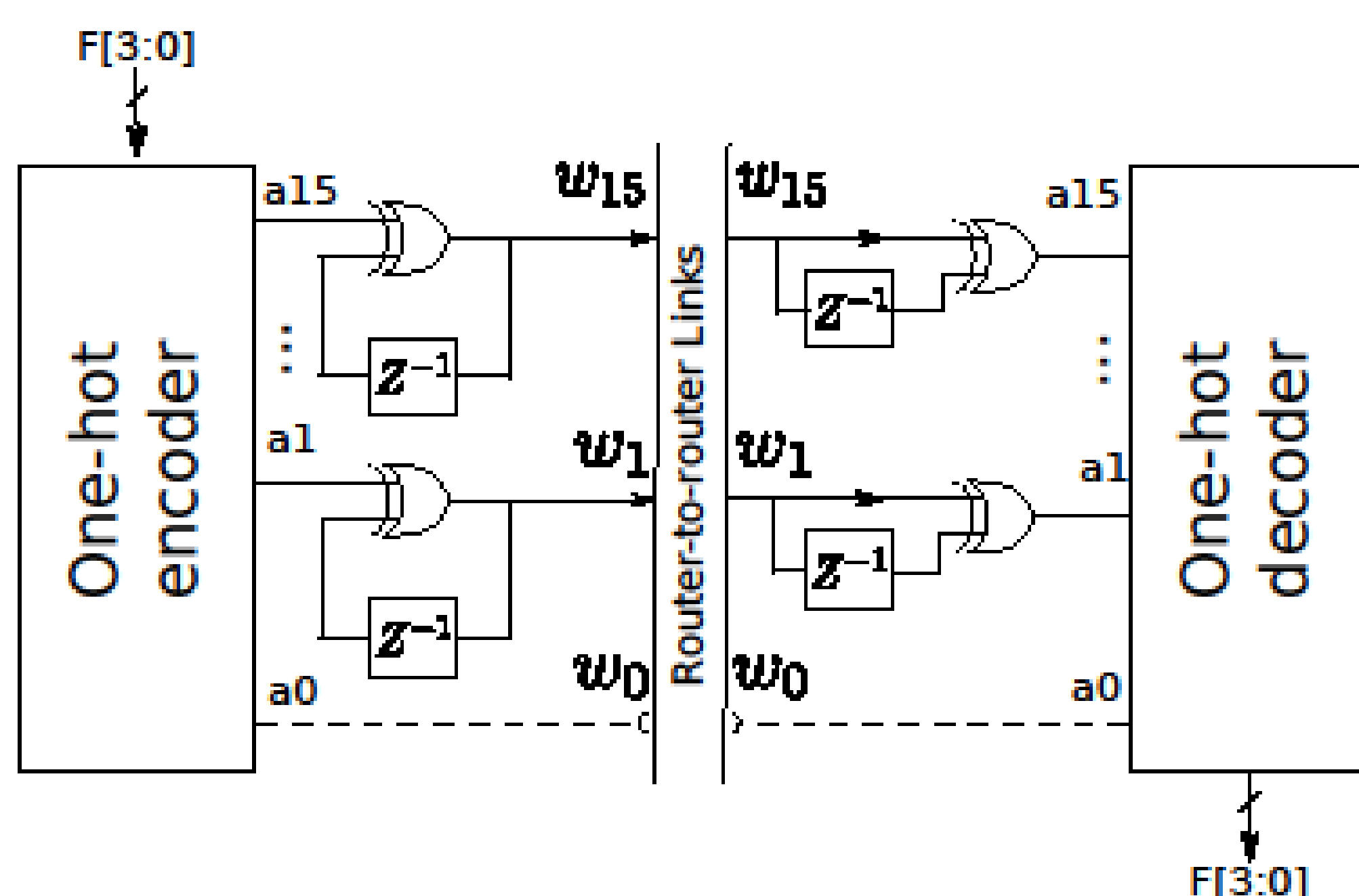
Simulate with Noxim-XT

- 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.