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ILP Based Routing Algorithm Design for ONoC

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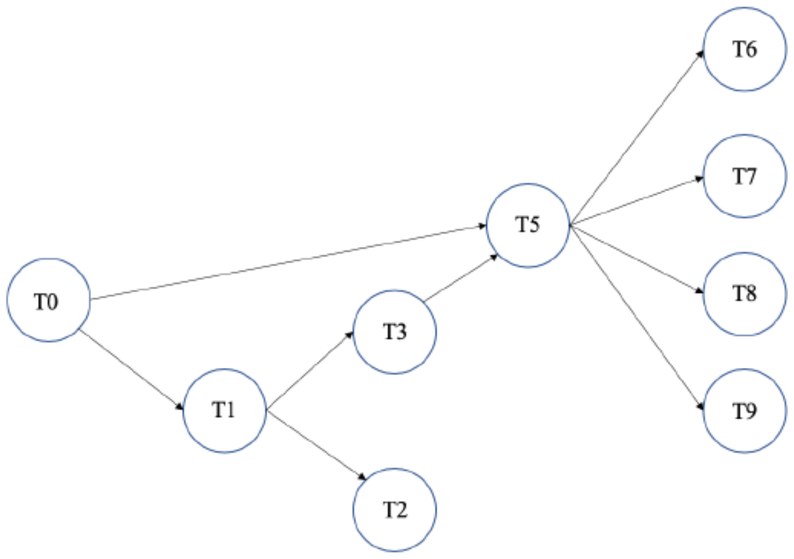
Project Objective

ONoC is increasingly used as an alternative for conventional interconnects. Common issues faced by ONoC are communication contention and thermal susceptibility which affect reliability of communication. The objective of this research was to develop a model that addresses these issues with an ILP model. The ILP model was implemented on AMPL IDE and solved with 'cplex' solver

Methodology

A multi-commodity flow model was adapted for inter-processor communication with the objective function of reducing total cost. The cost is related to the amount of energy required to maintain a thermal-reliable path for the ONoC. Communication contention is included as a constraint in this model.

To further improve the model, thermal aware task–mapping was used to ensure a relatively even distribution of tasks to reduce heat produced by each processor and maintain thermal reliability.




```
set {(i,j) in ARCS: x[i,j,1,10] == 1}  := (2,5) (3,2) (4,7) (5,4);

x[i,j,1,10] [*,*]
:   1   2   3   4   5   6   7   8   9    :=
1   .   0   .   0   .   .   .   .   .
2   0   .   0   .   1   .   .   .   .
3   .   1   .   .   .   0   .   .   .
4   0   .   .   .   0   .   1   .   .
5   .   0   .   1   .   0   .   0   .
6   .   .   0   .   0   .   .   .   0
7   .   .   .   0   .   .   .   0   .
8   .   .   .   .   0   .   0   .   0
9   .   .   .   .   .   0   .   0   .
;

set {(i,j) in ARCS: x[i,j,2,10] == 1}  := (7,8) (8,9);

x[i,j,2,10] [*,*]
:   1   2   3   4   5   6   7   8   9    :=
1   .   0   .   0   .   .   .   .   .
2   0   .   0   .   0   .   .   .   .
3   .   0   .   .   .   0   .   .   .
4   0   .   .   .   0   .   0   .   .
5   .   0   .   0   .   0   .   0   .
6   .   .   0   .   0   .   .   .   0
7   .   .   .   0   .   .   .   1   .
8   .   .   .   .   0   .   0   .   1
9   .   .   .   .   .   0   .   0   .
;
```

Results

In comparison to commonly implemented solutions, the ILP model saw a more even distribution of tasks across processors and saw an average improvement of 43.6%.