



DESIGN, AUTOMATION & TEST IN EUROPE

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The European Event for Electronic
System Design & Test

PhoNoCMap: an Application Mapping Tool for Photonic Networks-on-Chip

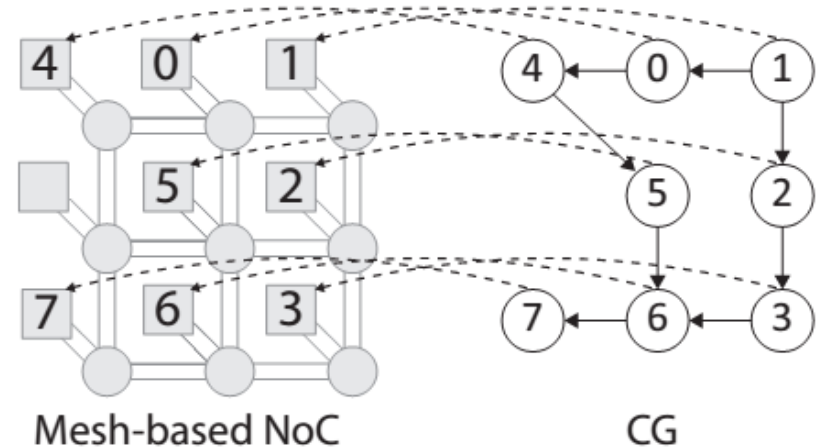
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Application-specific Mapping

- Previously proposed approaches [1][2] target electronic NoCs
 - Goals: hop count, latency, energy efficiency
- Silicon photonics
 - Different metrics that have no equivalent in the electronic domain: insertion loss, optical crosstalk noise
- Application-specific mapping optimization provides an important opportunity to face these problems
 - Suitable for embedded applications whose traffic pattern can be statically characterized



[1] Hu, Jingcao, and Radu Marculescu. "Energy-aware mapping for tile-based NoC architectures under performance constraints." Proceedings of the 2003 Asia and South Pacific Design Automation Conference. ACM, 2003.

[2] Murali, Srinivasan, and Giovanni De Micheli. "SUNMAP: a tool for automatic topology selection and generation for NoCs." Proceedings of the 41st annual Design Automation Conference. ACM, 2004.

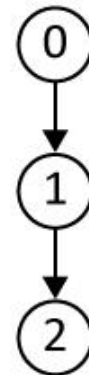
Motivational example

The impact of two different mapping solutions on the crosstalk noise.

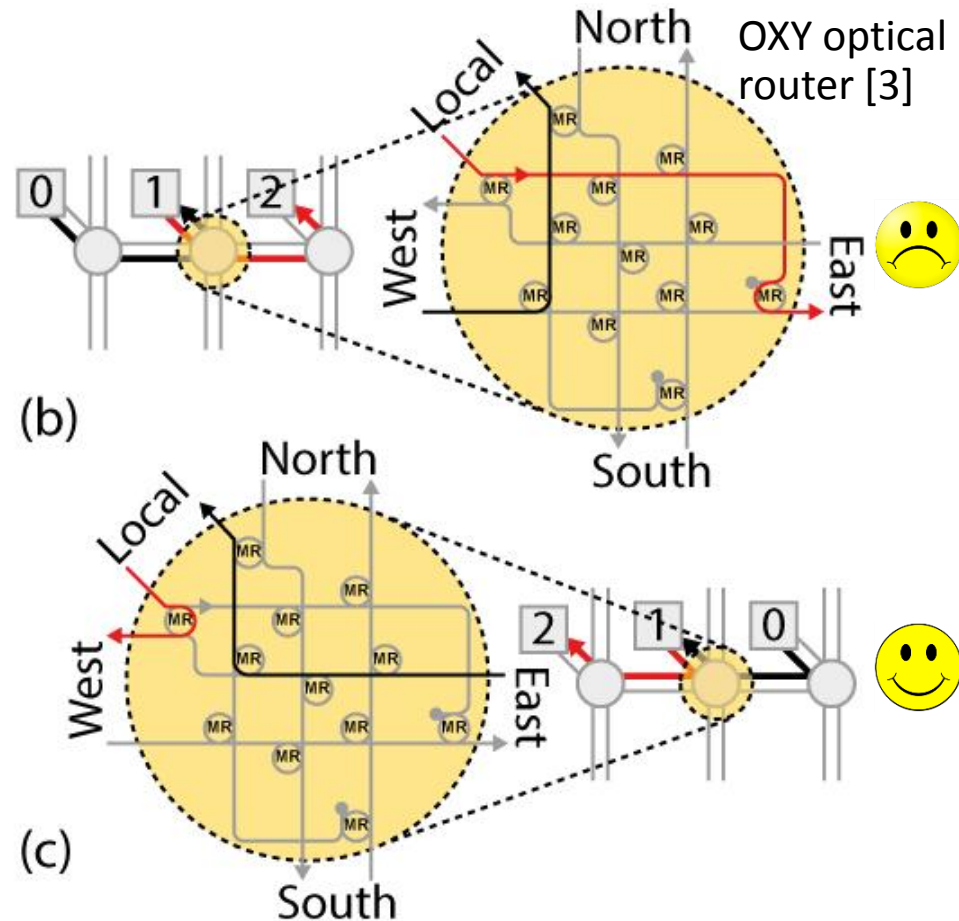
(a) Some communication requirements of an example application.

(b) A mapping solution where two optical signals induce crosstalk noise to each other when reaching the same waveguide crossing.

(c) A different mapping solution where the two optical signals do not induce crosstalk noise to each other.



(a)

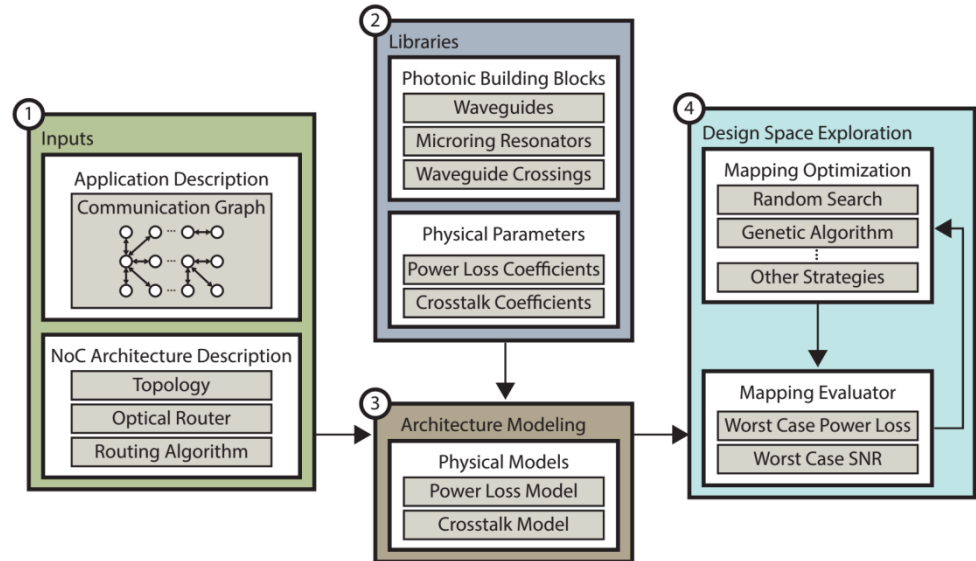


[3] Gu, Huaxi, Jiang Xu, and Zheng Wang. "A novel optical mesh network-on-chip for gigascale systems-on-chip." *Circuits and Systems, 2008. APCCAS 2008. IEEE Asia Pacific Conference on. IEEE*, 2008.

PhoNoCMap

PhoNoCMap:

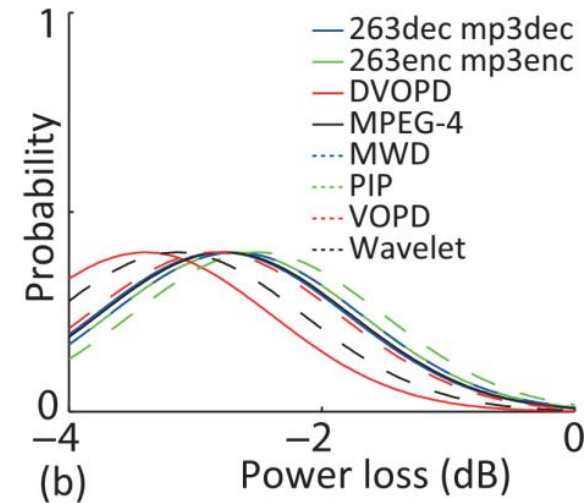
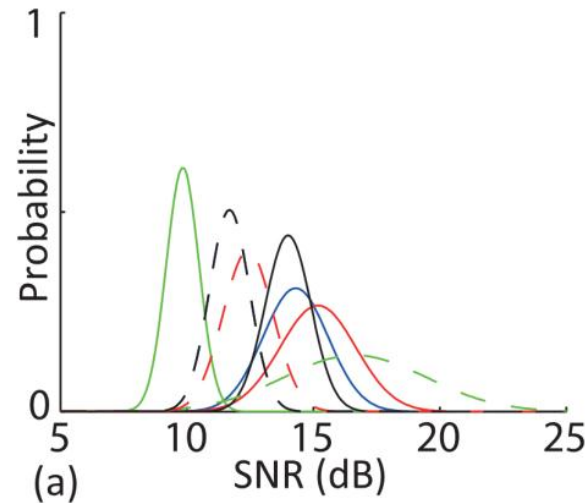
- Open source tool – please visit our page:
wpage.unina.it/edoardo.fusella/phonocmap/
- Automatically assigns application tasks to the NoC tiles minimizing the worst-case either insertion loss or crosstalk noise
- Released with:



1. Four topologies:
Mesh
Unfolded torus
Folded torus
Unfolded torus (Optimized floorplan [Feng et al. 2013])
2. Six optical routers:
OXY [Gu et al. 2008a]
ODOR [Gu et al. 2008b]
Cygnus [Gu et al. 2009]
Crux [Xie et al. 2010]
Crossbar [Poon et al. 2009]
[Ji et al. 2011]
3. Two objectives:
crosstalk noise
insertion loss
4. Three mapping optimization algorithms:
random search
genetic algorithm
list-based algorithm

Results

- Probability distribution of the (a) SNR and (b) power loss related to 100000 mapping solutions randomly generated for eight multimedia applications



- Comparison with non optimized mapping:
 - 3,67x SNR
 - 2x Power loss

