

Surface Wave Communication System for On-chip and Off-Chip System Interconnects

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Outline

- ▶ Introduction
- ▶ Surface wave
- ▶ Hybrid architecture
- ▶ Analysis of link power dissipation
- ▶ Area estimation
- ▶ Preliminary results
- ▶ Conclusion

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Introduction

- ▶ Scalability is the issue:
 - System-on-chip
 - Network-on-chip
 - Global communication
 - Alternative communication fabric



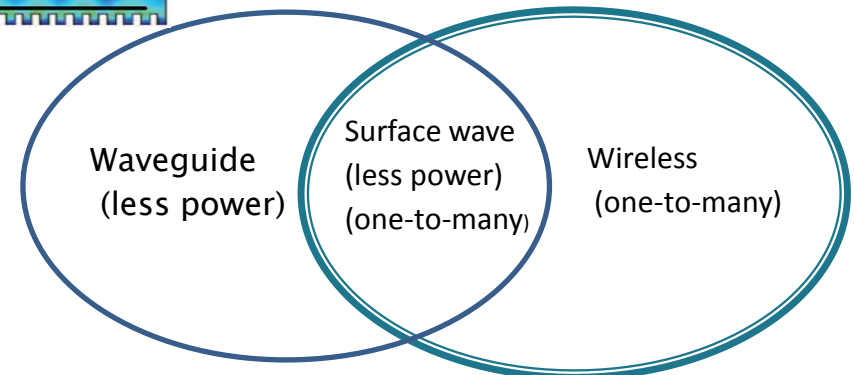
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Zenneck Surface Wave

► Why surface wave :

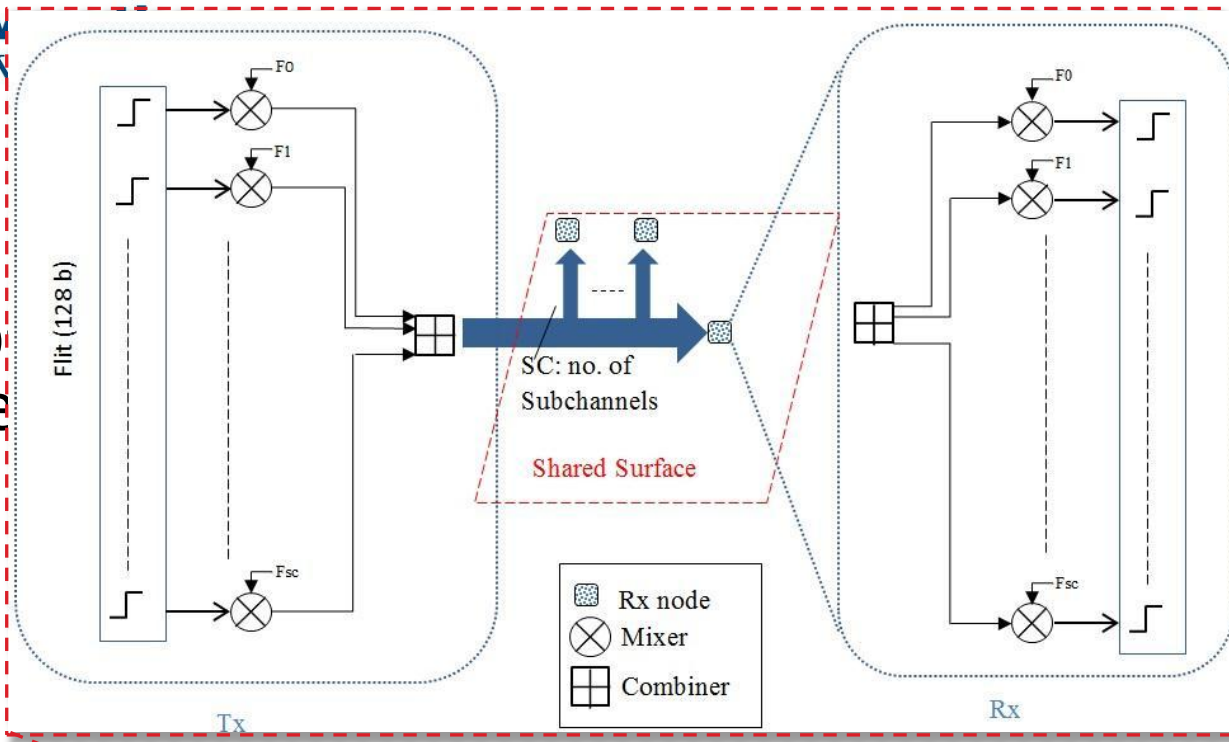
- Lower cost to implement:
 - Does not require non-CMOS devices to be integrated (e.g. Optical Interconnect)
 - less industrial challenges(e.g. 3D technology)
- Consume less power than wireless RF
- Provide one-to-many communication unlike(RF waveguide transmission lines)



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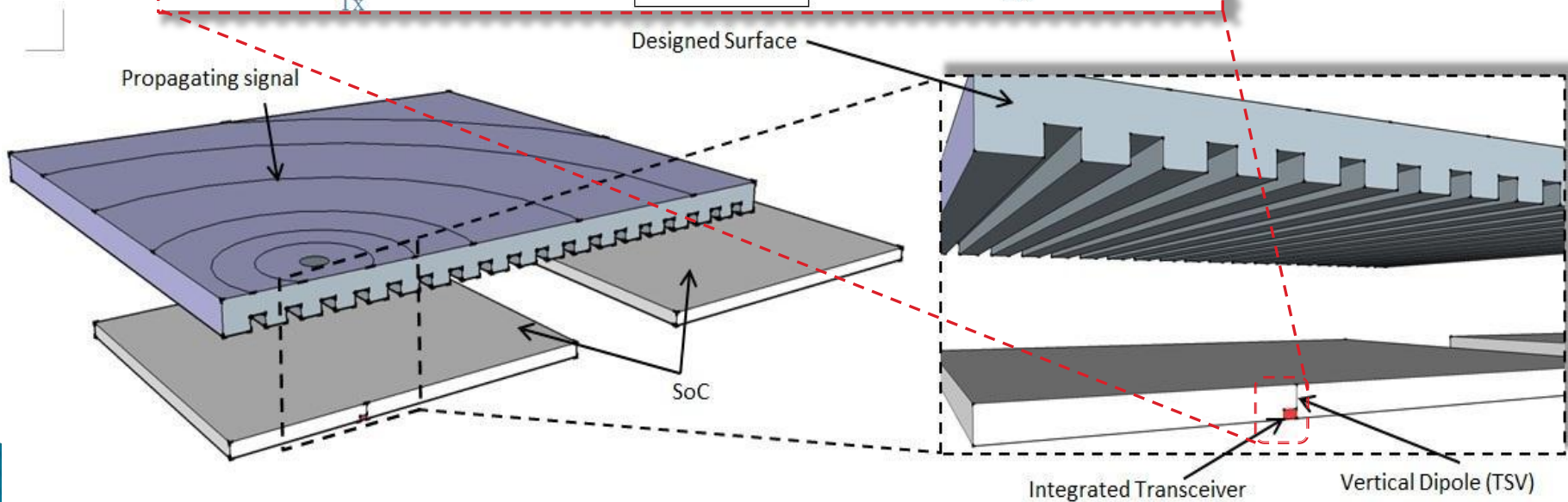
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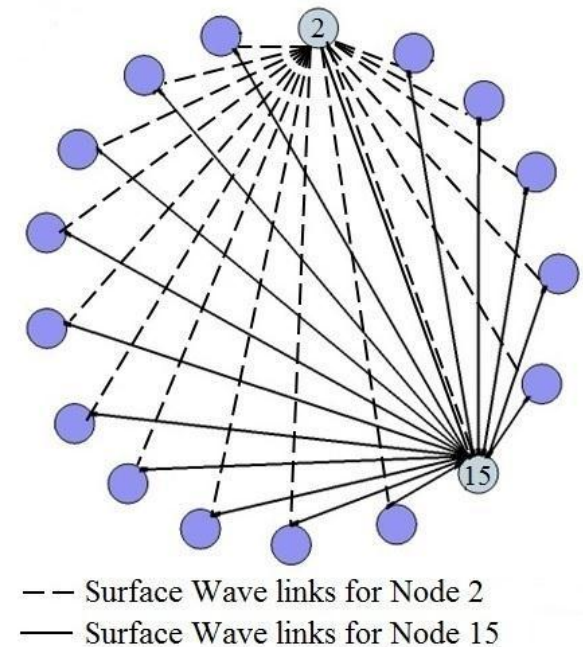
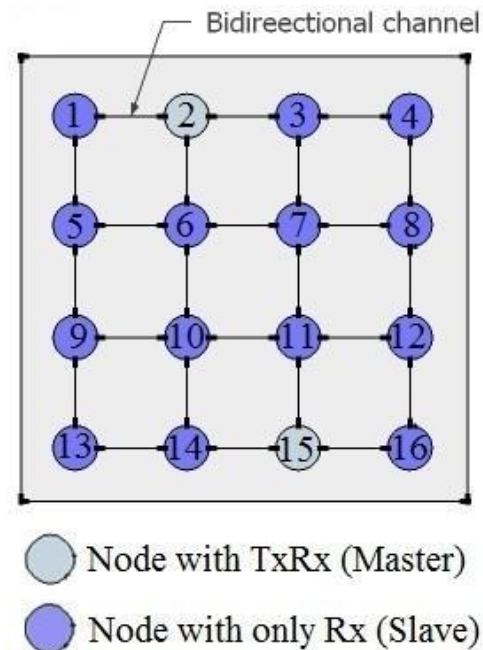


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Hybrid Architecture

- ▶ Shared media and limited number of frequency channels
- ▶ wire based local communication:
 - scale well with technology
 - cheapest implementation cost
- ▶ Hybrid multilayer Network:



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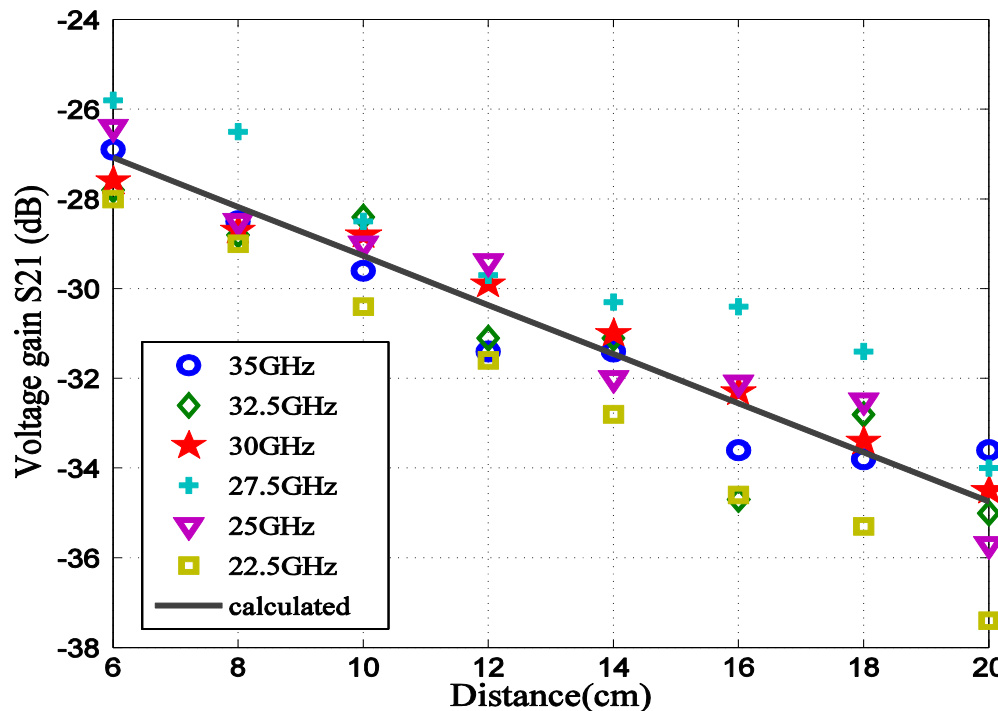
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Analysis of link power dissipation

- ▶ Proposed surface acts as wave guide of the propagated signal:

- $|V^+|_d = |V^+|_0 e^{-\alpha d}$ (1)

- $S_{21} = E + 20 \log e^{-\alpha d}$ (2)



$$\alpha \approx 6.33$$

$$E \approx -23.8$$

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Area estimation

- ▶ Area overhead consideration for the proposed Interconnect fabric

NoC component	Baseline Architecture	SWI Hybrid Architecture (proposed)	RF-I with transmission line
Router (mm ²)	1.08533	1.51237	1.51237
RF circuit (mm ²)	–	0.408	0.463
Link (mm ²)	–	–	0.17152
active area overhead rate to baseline arch.(% of total die)		2.29%	2.3%

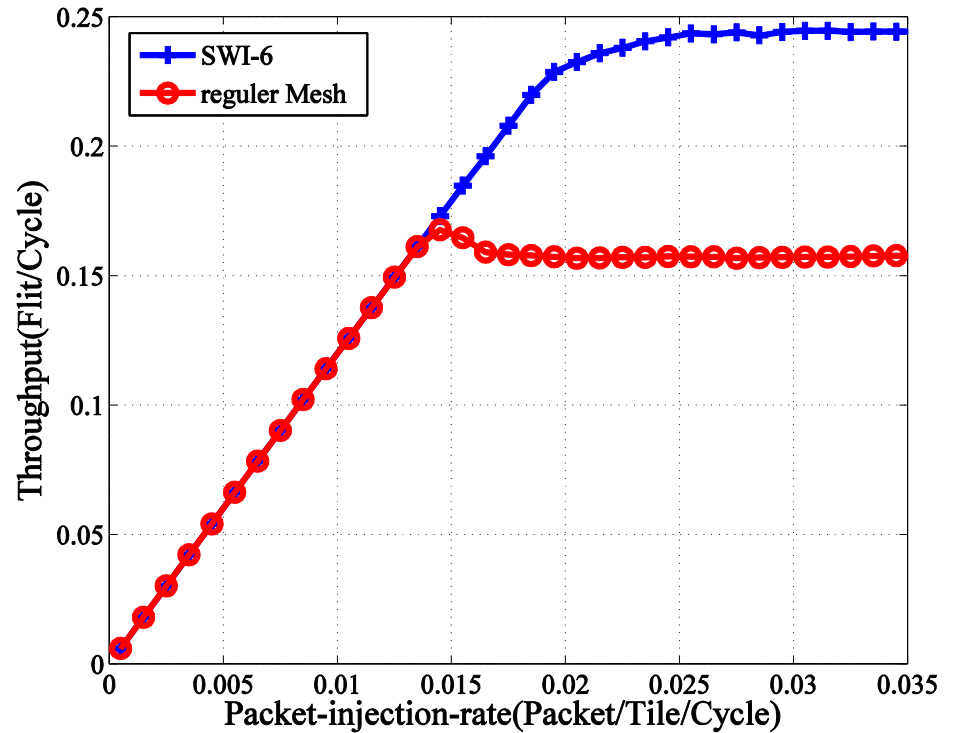
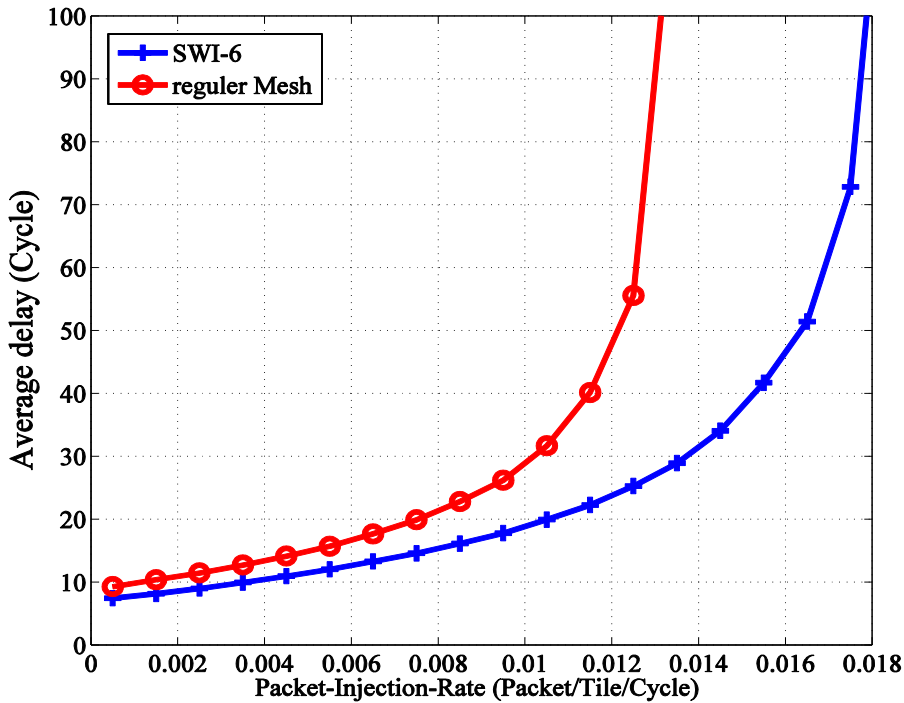
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Performance results

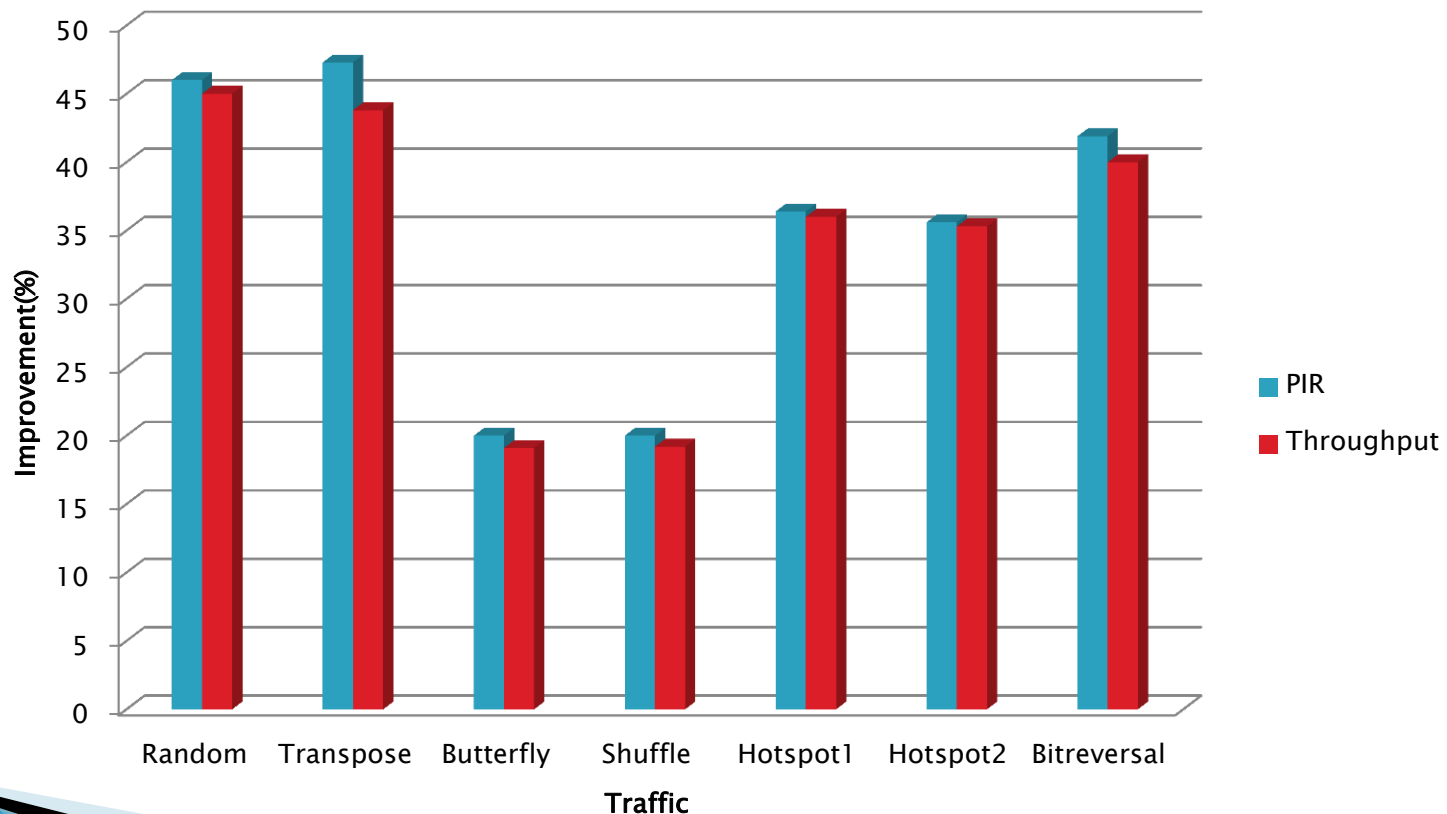
6x4 Network average delay vs. PIR for Hybrid and Baseline Architecture

6x4 Network Throughput vs. PIR for Hybrid and Baseline Architecture



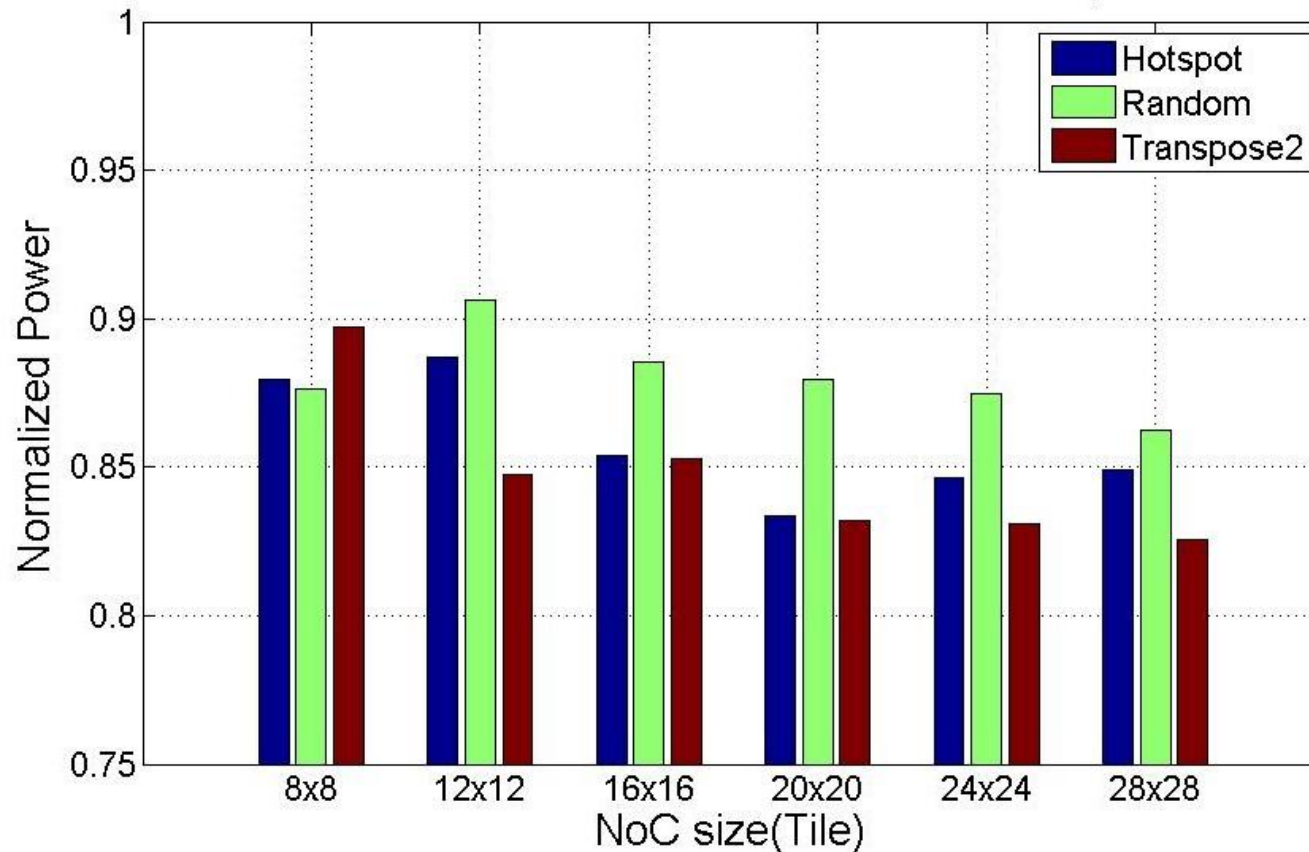
Performance results

- Hybrid-Arch. PIR and throughput improvement over Baseline Arch. At the edge of Network Saturation



Power results

- ▶ Normalized Power consumption vs. Baseline architecture for Different NoC size, traffic



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Conclusion and Future Work

- ▶ Scalability issues in global communication
- ▶ Hybrid architecture (metal and SWI for local and global Communication, respectively)
- ▶ Significant potential of the proposed architecture to mitigate these issues with relatively small area penalty
- ▶ Future work includes developing an optimized topology on design time or on the fly, as well as, investigating 1-to-M/M-to-1 traffic pattern for this fabric.

THANK YOU

