BBC: Wireless Interconnect Network on Chip for Broadcast-Based Parallel Computing

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Background

On-Chip Data Communication Issues

- Need for data rate increase
- Energy efficiency
- Many-core architectures
- Parallelism, cache coherence

Solutions

- 3D interconnects
- Optical Interconnects (See CominLabs "3D Manycores" project)
- RF guided interconnect
- RF Wireless interconnect

Our main focus in this project will be on **RF Wireless Interconnect (WiNoC)**

Objectives of BBC project

Main objectives of BBC project

- Evaluation of the contribution of RF-radio link for the intra-chip interconnect
- Definition of new opportunities for parallelism management and concur-rent memory accesses

Answer to the question:

"In which cases RF wireless links are attractive and in which cases other solutions are preferable?"

- Comparison with other interconnect solutions, especially with the results issues from 3DCORE project

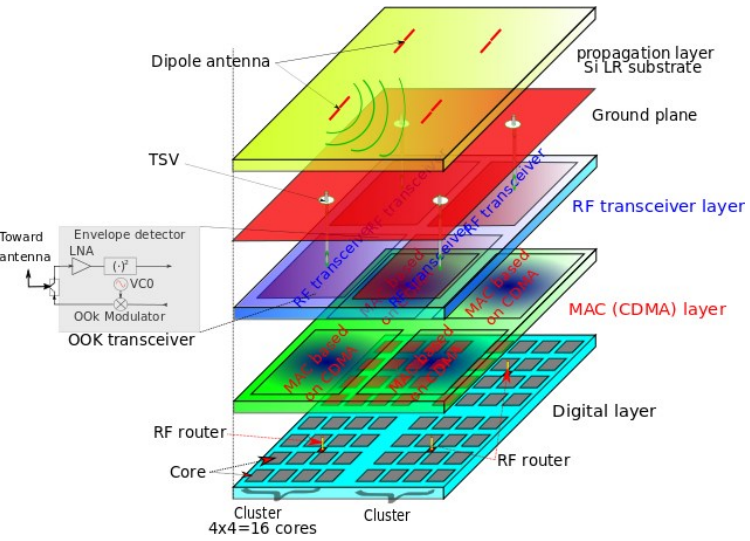


Illustration of a Wireless network on Chip

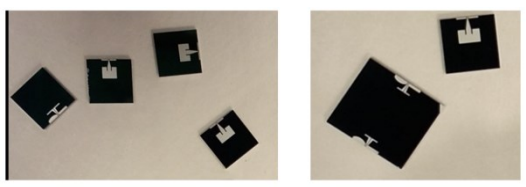
BBC project is divided in 3 Work-Packages:

- WP1: Physical layer
- WP2: New low power MAC
- WP3: New protocols based on Broadcast

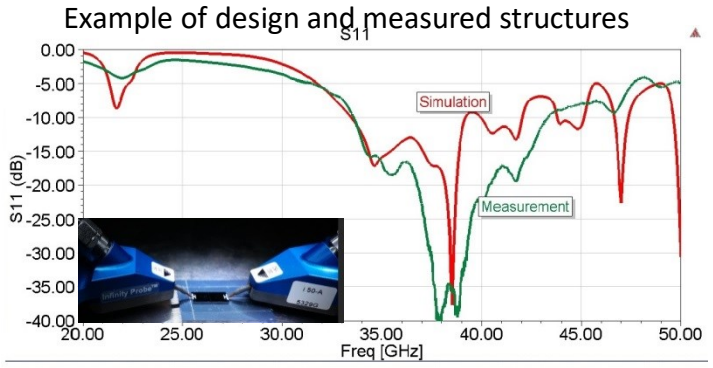
WP1: Physical layer

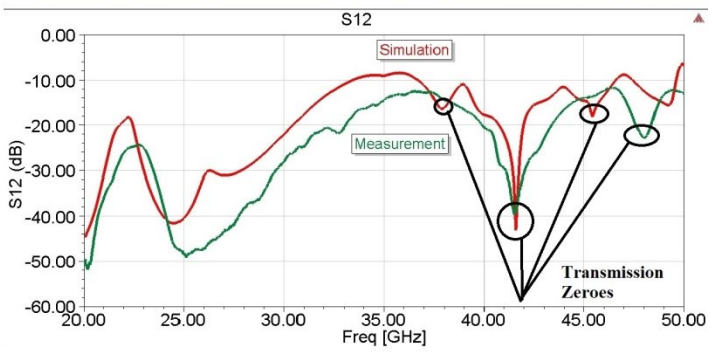
Aims:

- Antenna design for WiNOC
- Channel Characterization using EM simulations and measurements
- Study of RF transceiver for WiNoC possibility



Example of design and measured structures





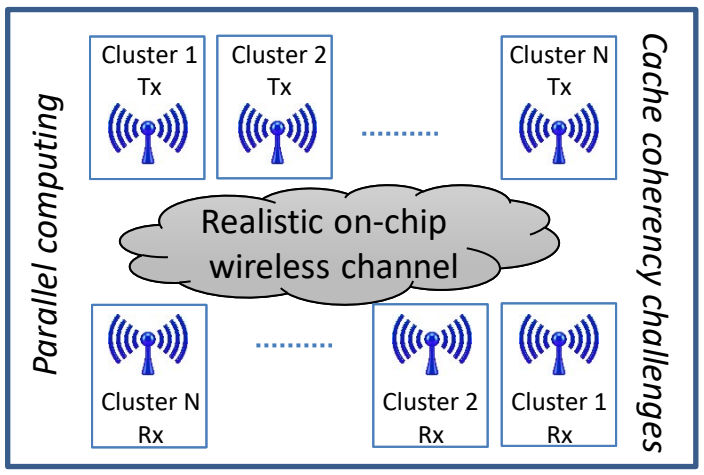
Validation of antenna design and EM simulation of Channel on Si Substrate at 30 GHz

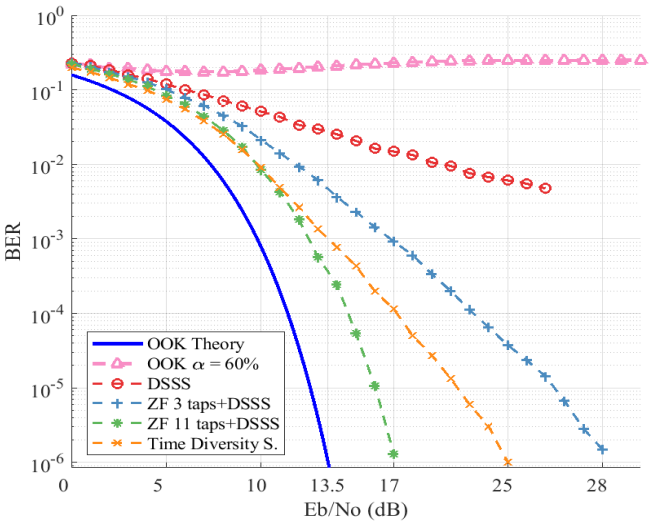
- Build a base for channel model

WP2: Medium Access

Study best access techniques supporting channel compensation techniques

- To offer high communication reliability over a realistic on-chip wireless channel
- To share the medium between clusters
- To enable and optimize new features that will improve classic NoC communications



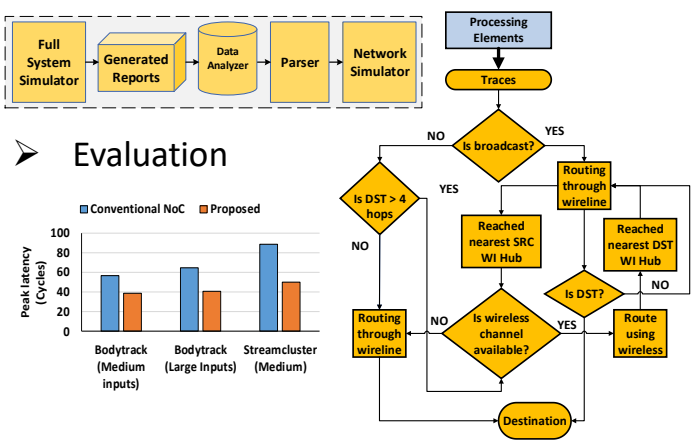


WI Block	Area (μm^2)	Power (mW)
DSSS Codec	313.18	0.43
TDS Codec	401.63	0.82
Optimized TDS Codec	317.42	0.63
3-tap ZF with DSSS Codec	490.41	0.98
11-tap ZF with DSSS Codec	1967.37	4.04
8-bit Serializer (10 Gbps)	21.8	0.1741
32-bit Serializer (1.25 Gbps)	49	0.04391
32-bit Deserializer (1.25 Gbps)	50	0.044
4-bit ADC [29]	9000	16
OOK Transceiver [33]	not specified	20.8

WP3: New protocols based on broadcast

Aims:

- Efficient broadcast protocol for effective parallel computing
- Evaluation framework for hybrid networks



- Evaluation

Publications

- Ihsan El Masri (student), Thierry Le Gouguec, Pierre-Marie Martin, Rozenn Allanic, Cedric Quendo: **Integrated Dipole Antennas and Propagation Channel on Silicon in Ka Band for WiNoC Applications.** IEEE Workshop on Signal and Power Integrity, 2018 (submitted)
- Joel Ortiz, Olivier Sentieys, Christian Roland: **A Diversity Scheme to Enhance the Reliability of Wireless NoC in Multipath Channel Environment.** 12th IEEE/ACM International Symposium on Networks-on-Chip (NOCS), 2018 (submitted)
- Thierry Le Gouguec, Pierre-Marie Martin: **A 45-GHz Wireless Transmission for a Wireless Interconnect Network-on-Board.** 21th IEEE Workshop on Signal and Power Integrity, 2017