NoC-based Platform Architectures: methodologies and applications for channel decoding

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NoC-Based Platform Architecture for Multicore SoCs with specialized accelerators
- Energy-efficient computation ⇒ heterogeneous designs with regular processors and specialized hardware “accelerators”
- Heterogeneous designs with accelerators tend to be “irregular” and so more complex to design ⇒ tiled regular approach with Network-on-Chip (NoC) for inter-tile communication

Topics
- Virtual platform for fast Hw/Sw co-simulation based on SystemC and Transaction-Level Modeling (TLM)
- High-level synthesis of accelerators and network-interfaces ⇒ From SystemC/TLM to synthesizable RTL
- Hardware/Software interaction through platform API

NoC-Based architectures for flexible channel decoding
- Distributed turbo and LDPC code decoding ⇒ iterative algorithms exchanging information through complex communication patterns
- Flexible Decoder ⇒ wide variety of supported code lengths and rates: WiMAX, WiFi, 3GPP-LTE, HPAV, DVB-RCS, DTMB, CMMB

NoC-based decoders
- Processing elements (PEs) linked to routing elements (REs), arranged in a graph topology
- Extensive simulations show Kautz topology as optimal for LDPC and turbo decoding ⇒ short diameter, scalable, easy routing, small area

Node Architecture
- Simple RE ⇒ X-bar switch, F input FIFOs and output ports
- Routing algorithm ⇒ Shortest Path
- Communication is deterministic ⇒ destination memory locations are pre-computed and stored in a location memory

Memory Management in the Dark Silicon Era
- When accelerators are off, reuse memory as L3 cache
- >25% speedup on SPEC & Parsec benchmarks

NoC Dynamic Voltage and Frequency Scaling (DVFS)
- 2-voltage dithering (Vhi, Vlo) in a NoC switch simplifies DVFS, yet achieves power savings close to an ideal DVFS
- Closed-loop Voltage and Frequency selection

Latency-Insensitive RTL design of processor/memory
- Process-variation tolerant design ⇒ ~20% higher speed

Energy efficiency VS Area of flexible LDPC / turbo decoders
- Unmatched degree of flexibility (widest set of supported standards of the state of the art)
- Very good efficiency (turbo codes in particular) and area occupation