A Methodology and Simulator for the Study of Network Processors

ECE 697J
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Introduction

- Why do we want to simulate a system?
- What should we simulate in an NP?
Simulation

- Cheaper than building hardware
- Get understanding of
  - Behavior
  - Performance
  - Timing
- Explore configurations that are not feasible today
  - Next generations CMOS
  - Scalability
NP Simulation

• What to simulate?
  – Depends.
• Examples:
  – Processors
  – Network traffic
  – Memory subsystem
  – Switching fabric
• Combination of all: full system simulator
  – Paper calls it “holistic”
• Other approaches: only components
  – E.g., CommBench is “microrarchitect’s approach”
Component Network Simulator
Traces

- Network traffic that is fed to simulator
- Real traces:
  - Collected on real networks
  - Usually hard to obtain
- Synthetic traces:
  - Generated by network model
  - Can be scaled nicely
  - Do not contain packet payload
  - Usually based on traffic self-similarity
Cisco Toaster
Cisco Toaster

• 16 VLIW processors
  – ISA “optimized for network processing”: lookups, bit level ops, …
• Each column executes same code
  – Phase-shifted to avoid memory conflicts
• Memory system
  – 12kB instruction memory
  – 64 byte data cache
  – On-chip memory for “context”
  – Column-memory: 16kB on-chip, 256MB off-chip
Simulator Implementation

- C++ classes representing different Toaster components:
  - Cores, columns, buffers, memories
- Processors:
  - Count cycles and simulates stalls
- Memories:
  - Detailed modeling of memory transaction
- Paper claims “real-time simulator”
DiffServ Application

• Several classes of flows
  – WRR scheduler
• Main issues:
  – Constraint cycle budget (why?)
  – Deterministic behavior
• Make sure serviceable item can be found quickly
Results

• 100000 packets of 21 flows
• Measured delay and jitter
• Ideal memory system:
  – Delay: 2-18 ms
  – Jitter: 5-10 ms
• Real memory system:
  – Delay: 3-28ms
  – Jitter: 6-19ms
• Input rate definition is unclear:
  – How can 21 flows have 500+Mbps on four OC12 ports?
Summary

- Simulators are useful
  - Allows to experiment with architectures and applications
- Difficult to find balance between details and architecture-independence
- Simulations need to be described in detail to be meaningful
Next Class

• Design Space Exploration
  – Evaluation architectures analytically – not with simulations.