Configuration Scheduling Using Temporal Locality and Kernel Correlation

Santheeban Kandasamy
MASc Student
s2kandas@.uwaterloo.ca

Andrew Morton
Co-Supervisor
arrmorton@uwaterloo.ca

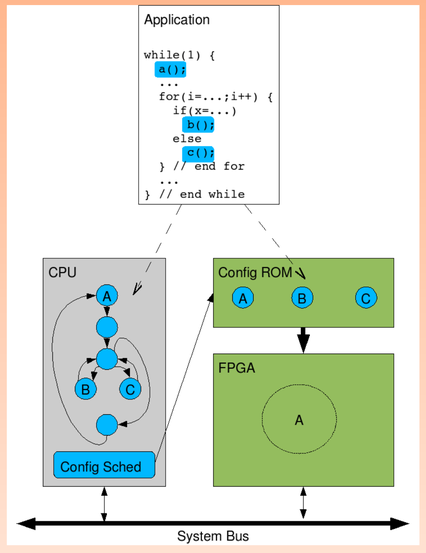
Wayne Loucks
Co-Supervisor
wmloucks@uwaterloo.ca

University of Waterloo
Canada

Configuration Scheduling

Goal
- reduce reconfiguration overhead
  - eliminate unbeneficial reconfigurations
  - perform reconfigurations in parallel with application

Scenario



Scheduler Modes
- monitoring
  - tracking sw kernel requests
- selection
  - determine kernel needed
- reconfiguration

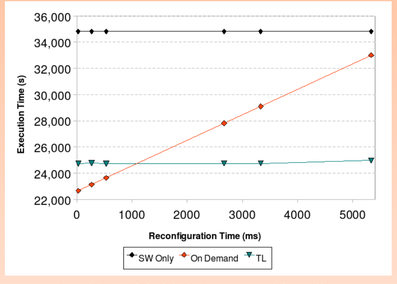
Temporal Locality

How it works
- Track recent kernel requests in history buffer
- Keep kernel with highest request frequency configured

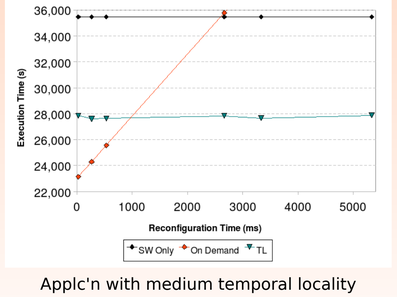
Pseudocode

```
update_history(kernel) ;
if kernel not configured then
  if reconfigure_required(kernel) then
    initiate _reconfiguration(kernel) ;
  end
  execute in software ;
else
  start_SPP ;
  wait_for_SPP ;
  get_result_SPP ;
end
```

Simulation Results



Applc'n with high temporal locality



Applc'n with medium temporal locality

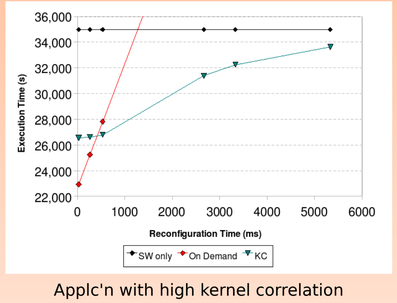
Kernel Correlation

How it works
- Track recent kernel requests w.r.t current kernel
- Anticipate request for next kernel and configure

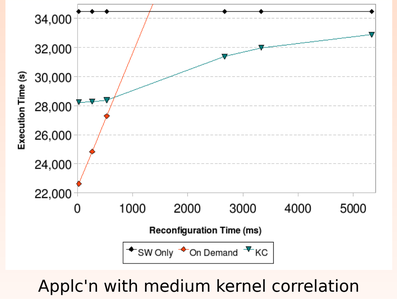
Pseudocode

```
update_history(kernel) ;
if kernel not configured then
  if reconfigure_required() then
    initiate _reconfiguration(next_kernel);
  end
  execute in software ;
else
  start_SPP ;
  wait_for_SPP ;
  get_result_SPP ;
  if reconfigure_required() then
    initiate _reconfiguration(next_kernel);
  end
end
```

Simulation Results



Applc'n with high kernel correlation



Applc'n with medium kernel correlation

SystemC Simulation

Timed Functional Model
- CPU = 100MHz 32-bit MIPS
- FPGA = Virtex II Pro
- scheduler times from instruction set simulator
- application times from MediaBench suite
- simulator marks passage of time

Energy and Power Consumption

Case	Algorithm	Power	Time	Energy
High TL	SW Only	105.0 mW	34812 s	3.66 kJ
	On-Demand	104.5 mW	27803 s	2.91 kJ
	TL	104.3 mW	24742 s	2.58 kJ
Medium TL	SW Only	105.0 mW	35471 s	3.72 kJ
	On-Demand	105.1 mW	35763 s	3.76 kJ
	TL	104.8 mW	27465 s	2.88 kJ
High KC	SW Only	105.0 mW	34976 s	3.67 kJ
	On-Demand	104.5 mW	27816 s	2.91 kJ
	KC	104.9 mW	26788 s	2.81 kJ
Medium KC	SW Only	105.0 mW	34484 s	3.62 kJ
	On-Demand	104.5 mW	27287 s	2.85 kJ
	KC	105.2 mW	28384 s	2.98 kJ

Summary

- temporal locality
  - only effective if $t_{config} > t_{sw} - t_{hw}$
  - can reduce energy consumption by reducing reconfigurations
- kernel correlation
  - can reduce execution time by configuring before demand
  - increases power but decreases energy due to shortened execution