ullink

Measuring directly from CPU : Hardware performance counters

Jean-Philippe BEMPEL
Performance Architect
@jpbempel
http://jpbempel.blogspot.com

Measuring

- Measuring time
  - System.CurrentTimeMillis()
  - System.nanoTime()
- Timestamps in logs
- Profiling

Précision

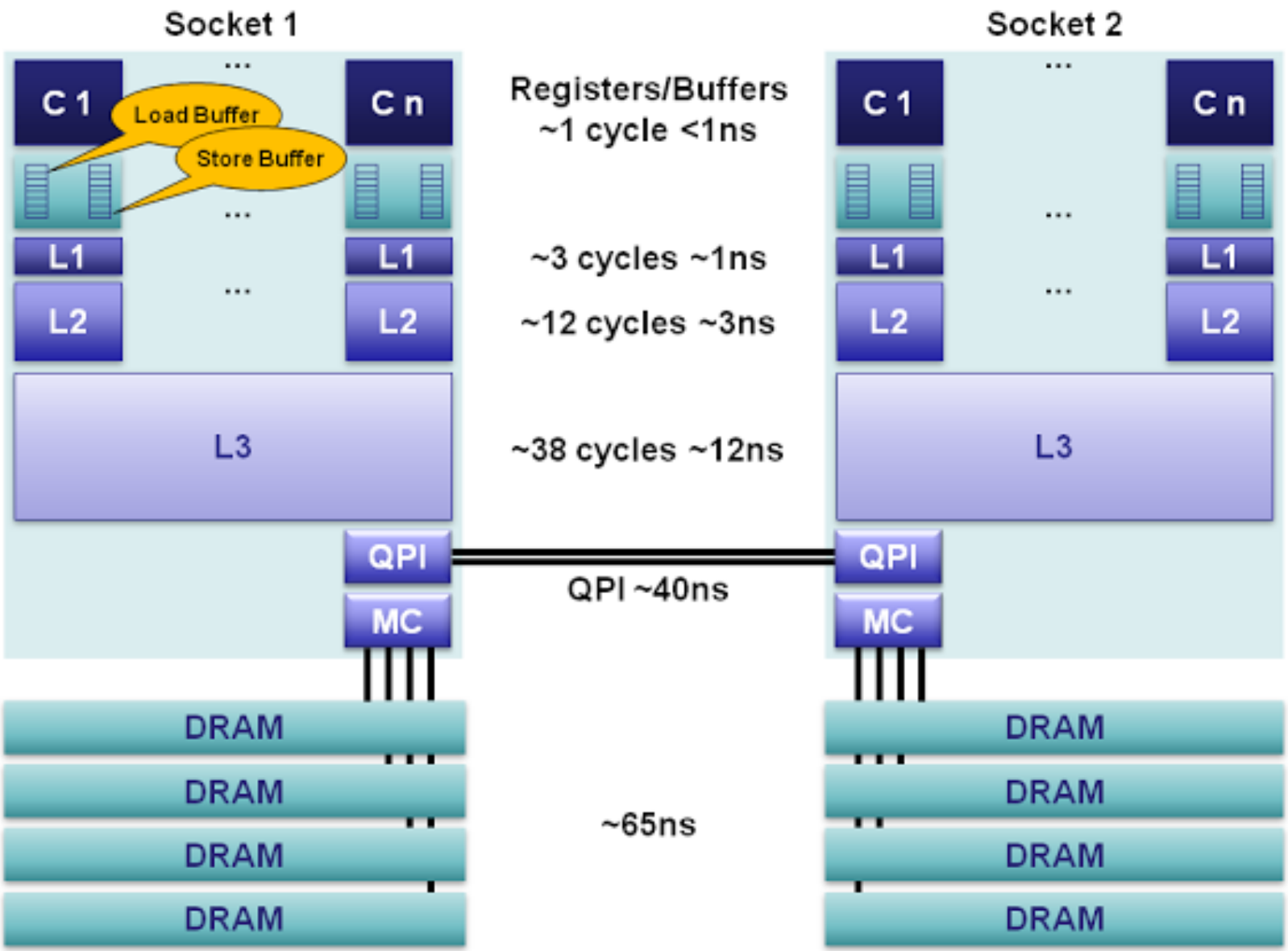
- System.currentTimeMillis()
  1ms -> 10-15ms depending on the OS

- System.nanoTime()
  500ns -> 1us

Compteurs de performance

- CPUs embeds PMU (Processing Monitoring Unit)
- Hardware counters on CPU behavior:
  - Cycles
  - Instructions
  - Caches
  - Memory accesses
- predefined or customizable

Hiérarchie mémoire



échelle de latence

Table 2.2 Example Time Scale of System Latencies

Event	Latency	Scaled
1 CPU cycle	0.3 ns	1 s
Level 1 cache access	0.9 ns	3 s
Level 2 cache access	2.8 ns	9 s
Level 3 cache access	12.9 ns	43 s
Main memory access (DRAM, from CPU)	120 ns	6 min
Solid-state disk I/O (flash memory)	50–150 µs	2–6 days
Rotational disk I/O	1–10 ms	1–12 months
Internet: San Francisco to New York	40 ms	4 years
Internet: San Francisco to United Kingdom	81 ms	8 years
Internet: San Francisco to Australia	183 ms	19 years
TCP packet retransmit	1–3 s	105–317 years
OS virtualization system reboot	4 s	423 years
SCSI command time-out	30 s	3 millennia
Hardware (HW) virtualization system reboot	40 s	4 millennia
Physical system reboot	5 m	32 millennia

- available on most linux distros
- Allow to access perf counters but allow other things (profiling, OS counters, …)
- list perf counters: `perf list`
- Profiler with default counters

```
perf stat java...
```

- Customize a perf counter

```
perf stat -e LLC-load-misses java ...
```

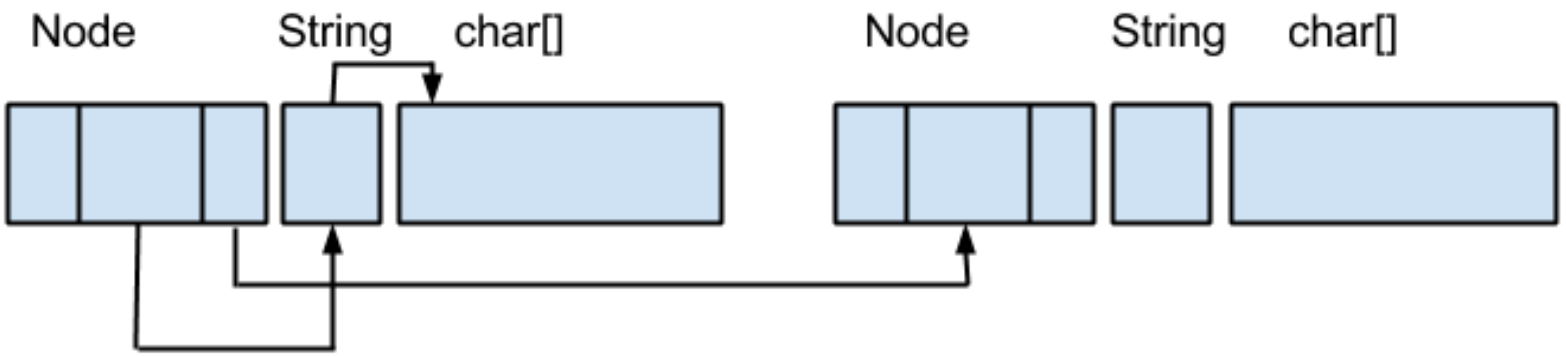
DEMO

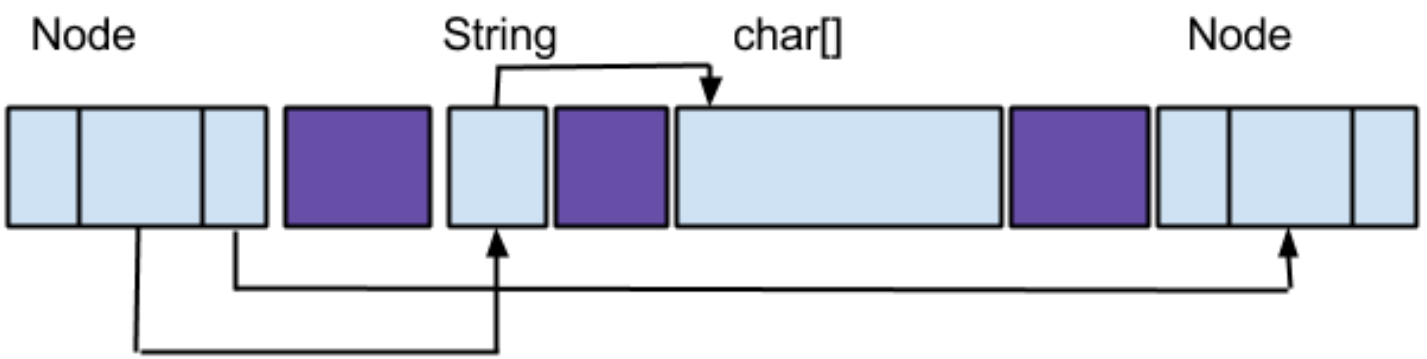
Overseer

- java library (JNI - linux only)
- Allow to use all available counters
- Based on libpfm4
  - Encodes counters based on CPU
- Profile precisely part of the code of applications

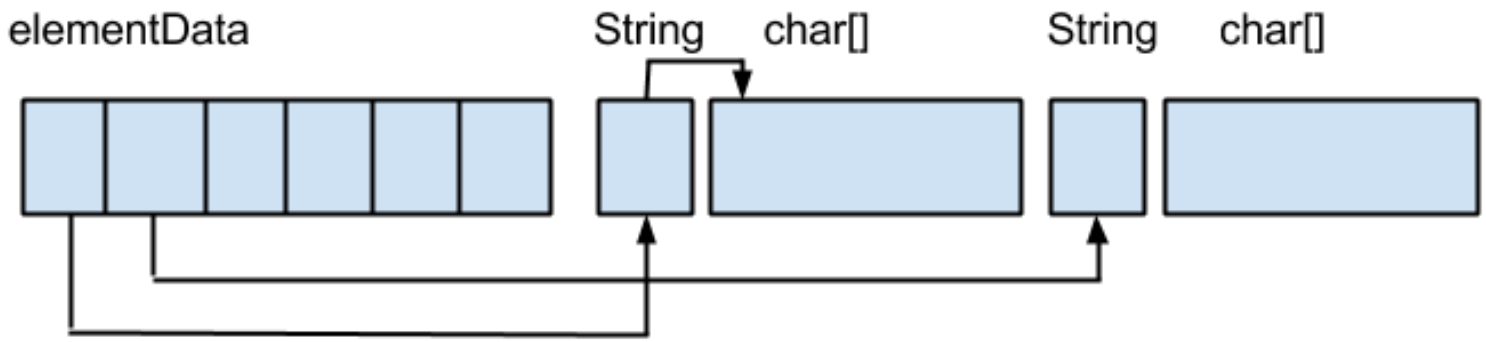
DEMO

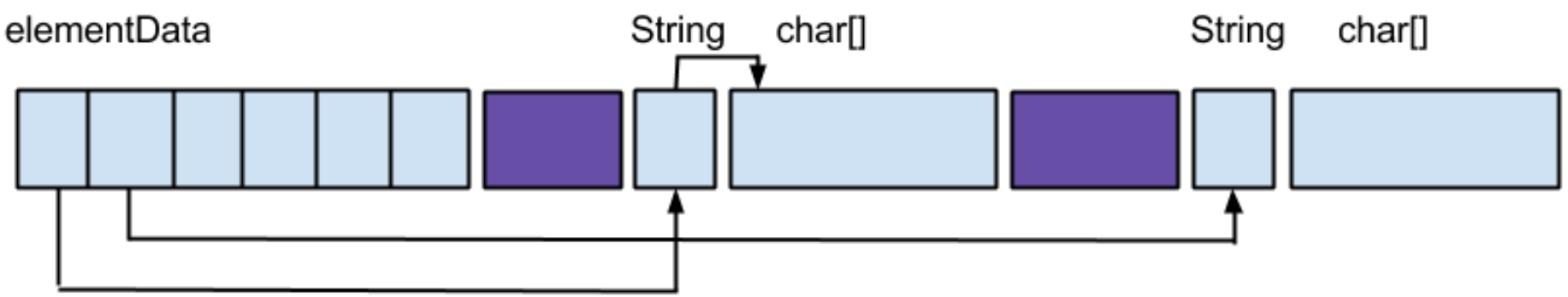
Memory layout: LinkedList



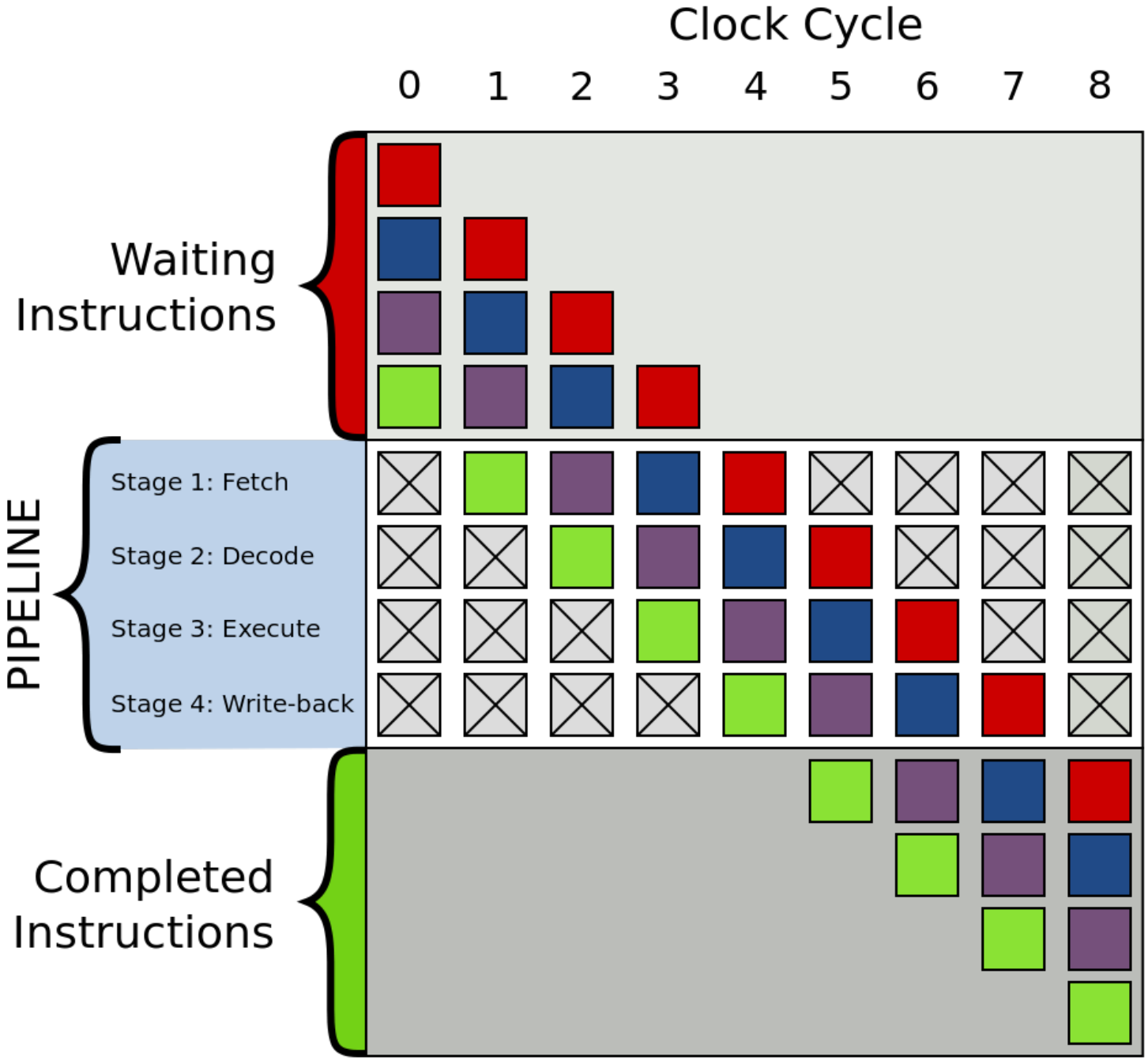


Memory layout: ArrayList





Pipeline


Clock Cycle
0
1
2
3
4
5
6
7
8
Waiting Instructions
PIPELINE
Stage 1: Fetch
Stage 2: Decode
Stage 3: Execute
Stage 4: Write-back
Completed Instructions

Liens

- Overseer library:
  - http://www.peternier.com/projects/overseer/overseer.php
- libpfm4:
  - http://perfmon2.sourceforge.net/

Thanks for your attention.

Questions?

AMERICAS

EUROPE

ASIA