Is the Atom (N330) processor ready for High Energy Physics?

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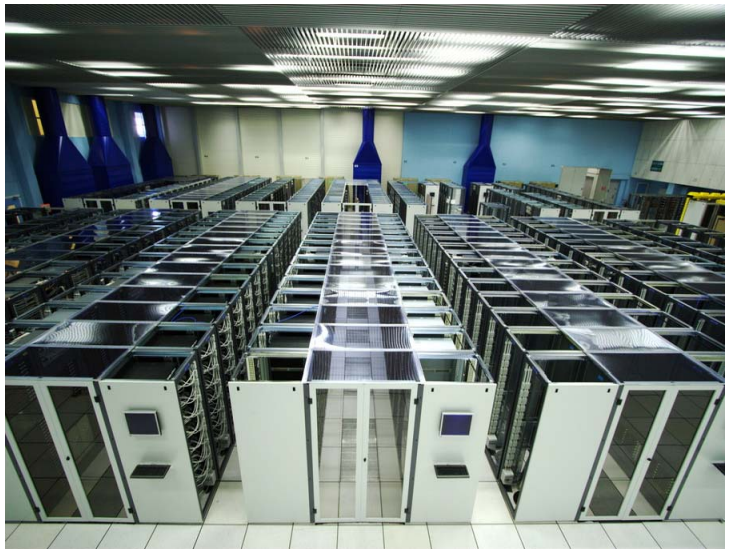

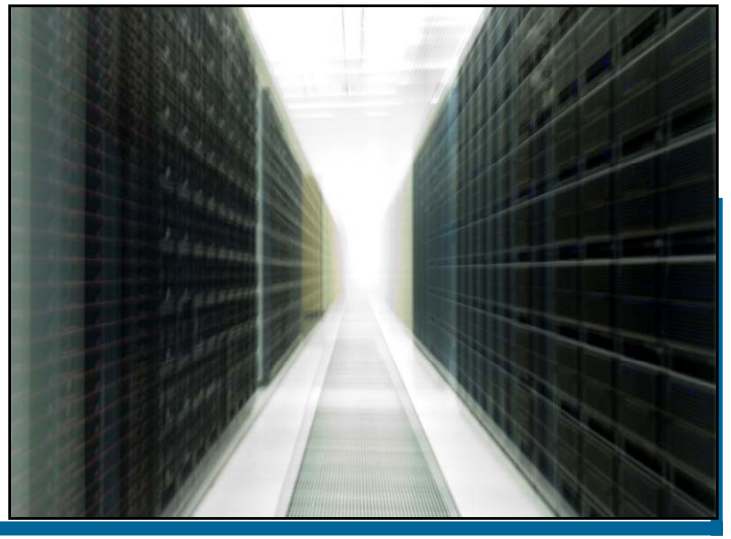

Contents

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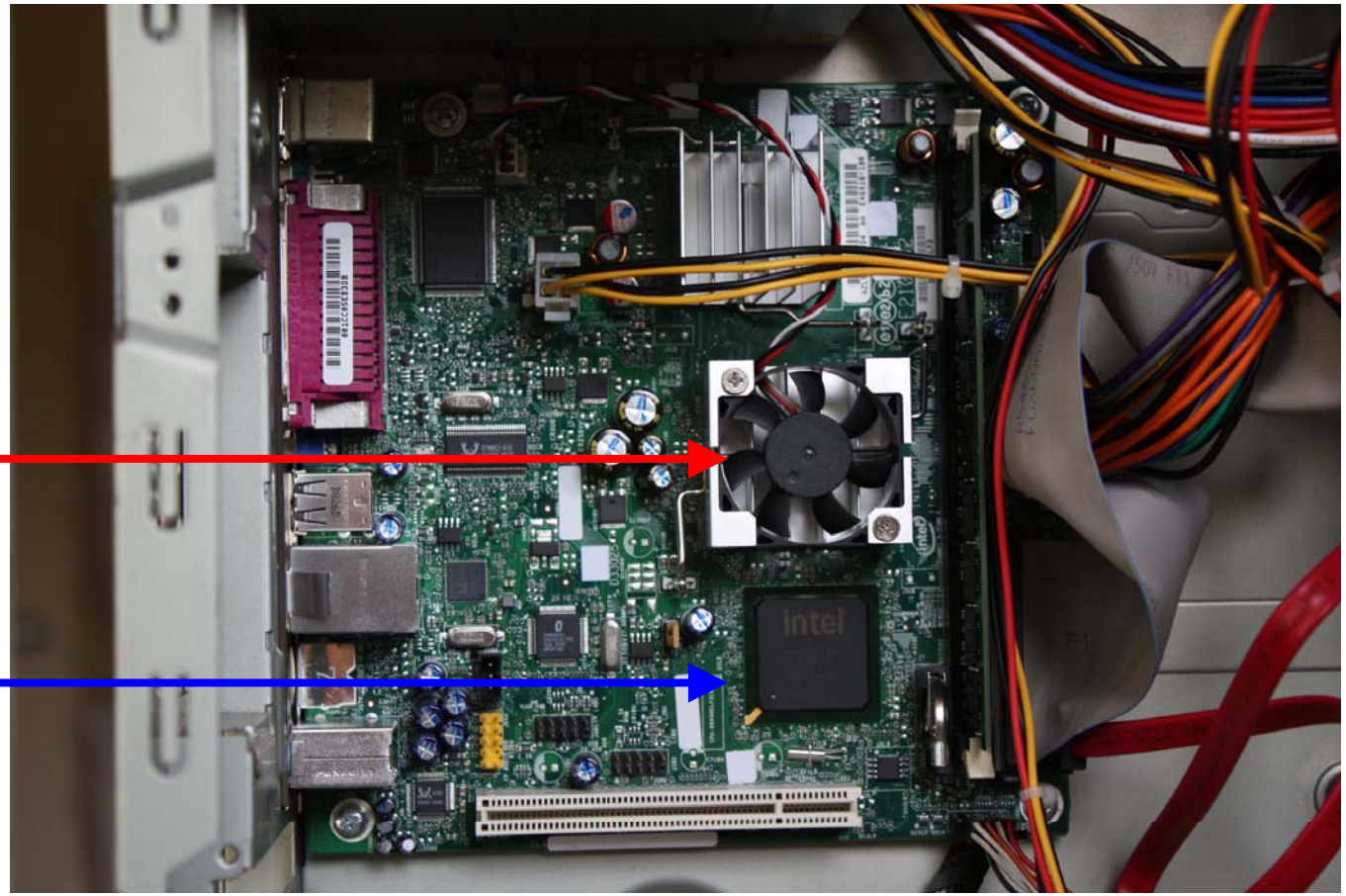
ATOM processor specifications

- **ATOM N330 is the biggest member in the current family:**

# cores	2
# hardware threads /core	2
Frequency	1.6 Ghz
Max (certified) memory config.	2 GB
L1 cache	32KB+24KB
L2 cache (per core)	512KB
Front-side bus frequency	800 MHz
64-bit enabled	YES
Extensions	SSSE3
In-order execution	YES

ATOM motherboard

- **Note that the fan is not on the processor but on the D945GC chipset**



Power measurements

- **Configuration used (Atom):**
  - One 2GB DDR2 memory module (667 MHz)
  - 350W power supply (best we could find at the time)
  - Hard disk + DVD drive
  - Results:
    - Active power: 46.5 W (idle), 50.7 W (cpuburn)
    - Apparent power: 65.3 VA (idle), 70.1 VA (cpuburn)
    - Power factor: 0.71-0.72
  - Main consumer: Chipset ~25 W !

Price estimates (1)

- **Taken "anonymously" from the Web (Oct. 08):**

Motherboard+CPU	110 CHF
2GB DDR2 memory	30 CHF
Power supply, drives	110 CHF
Total	250 CHF

Atom

2x E5472 CPU	3500 CHF
1x4GB DDR2 memory	300 CHF
Other (board, PSU, drives)	1400 CHF
Total	5200 CHF

Harpertown

Of course, we can discuss "endlessly" whether the comparison is fair or not, so it is just meant as an indication!

Price estimates (2)

- **Memory adjustment (include 2GB/process)**
  - Taken "anonymously" from the Web (Oct. 08):

Motherboard+CPU	**110 CHF**
2*4GB DDR2 memory	**150 CHF**
Power supply, drives	**110 CHF**
Total	**370 CHF**

Atom

2x E5472 CPU	**3500 CHF**
4x4GB DDR2 memory	**1200 CHF**
Other (board, PSU, drives)	**1400 CHF**
Total	**6100 CHF**

Harpertown

Software configuration

- **Atom:**
  - Fedora Core 9 (Intel-64)
  - Kernel 2.6.25
  - gcc 4.3.0
- **Harpertown:**
  - SLC 5 (Intel-64 mode)
  - Kernel 2.6.xx
  - gcc 4.3.0
- **icc (Intel compiler also tested)**
  - Ratios were similar to those with gcc

Benchmark results

- **“test40” from Geant4 (in summary):**
  - Atom baseline: 1 process at 100% throughput at 47W
  - Atom peak: 4 processes at 302% throughput at 50W
  - Harpertown: 8 processes at 3891% throughput at 265W

SETUP	#proc	USER TIME: Runtime AVG (us)	USER TIME: % of 1 proc	ACTIVE: POWER (W)	ADVANTAGE: Workload	ADVANTAGE: Throughput	ADVANTAGE: Throughput per Watt
ATOM 330 @ 1.6 GHz Fedora 9, GCC 4.3, 2GB RAM	1	156	100%	47 W	100%	100%	100%
	2	157	100%	48 W	200%	199%	195%
	3	192	123%	49 W	300%	244%	234%
	4	207	132%	50 W	400%	302%	287%
Harpertown @ 3.0 GHz SLC 4.7, GCC 4.3, 4GB RAM	1	32	21%	186 W	100%	488%	123%
	2	32	21%	202 W	200%	973%	227%
	4	32	21%	232 W	400%	1944%	394%
	8	32	21%	265 W	800%	3891%	690%

Benchmark results (cont'd)

- **"test40" from Geant4 (memory adjusted):**
  - Atom baseline: 1 process at 100% throughput at 53W
  - Atom peak: 4 processes at 302% throughput at 56W
  - Harpertown: 8 processes at 3891% throughput at 290W

	SETUP	USER TIME		ACTIVE	ADVANTAGE		
	#proc	Runtime AVG (us)	% of 1 proc	POWER (W)	Workload	Throughput	Throughput per Watt
Atom 330 @ 1.6 GHz Fedora 9, GCC 4.3, 2x4GB RAM	1	156	100%	53 W	100%	100%	100%
	2	157	100%	54 W	200%	199%	196%
	3	192	123%	55 W	300%	244%	235%
	4	207	132%	56 W	400%	302%	286%
Harpertown @ 3.0 GHz SLC 4.7, GCC 4.3, 4x4GB RAM	1	32	21%	210 W	100%	488%	123%
	2	32	21%	225 W	200%	973%	229%
	4	32	21%	255 W	400%	1944%	404%
	8	32	21%	290 W	800%	3891%	711%

Benchmark results (cont'd)

- **"test40" from Geant4 (in summary):**
  - Atom baseline: 1 process at 100% throughput at 53W
  - Atom peak: 4 processes at 302% throughput at 56W
  - Harpertown: 8 processes at 3891% throughput at 290W
- **In other words (Harpertown/Atom ratios):**
  - Cost ratio was: 16.5 (with adjusted memory)
  - 12.9x throughput advantage
  - 5.2x power increase
- **Atom N330 could be interesting in terms of performance/franc**
  - Currently uninteresting when looking at performance/watt

Main issues with Atom system

- **Memory:**
  - Need support for large memories
  - Or: HEP software that needs less memory per process
- **Power consumption:**
  - Need a chipset with reduced consumption
  - And: More efficient power supply

Future options

- **Not just more memory, but also more efficient memory (DDR3)**
- **4-core ATOM processor**
- **Multi-threaded software process taking all CPUs**
- **Building μ-blades**
- **Better compiler optimization (for in-order execution)**

- **But, keep in mind that both Atom and Xeon families will evolve!**

http://openlab-mu-internal.web.cern.ch/openlab-mu-internal/Documents/2_Technical_Documents/Technical_Reports/2008/CERN%20Atom%20330%20analysis.pdf