On the Use of General-Purpose Multi-Core Processors in Networking Devices

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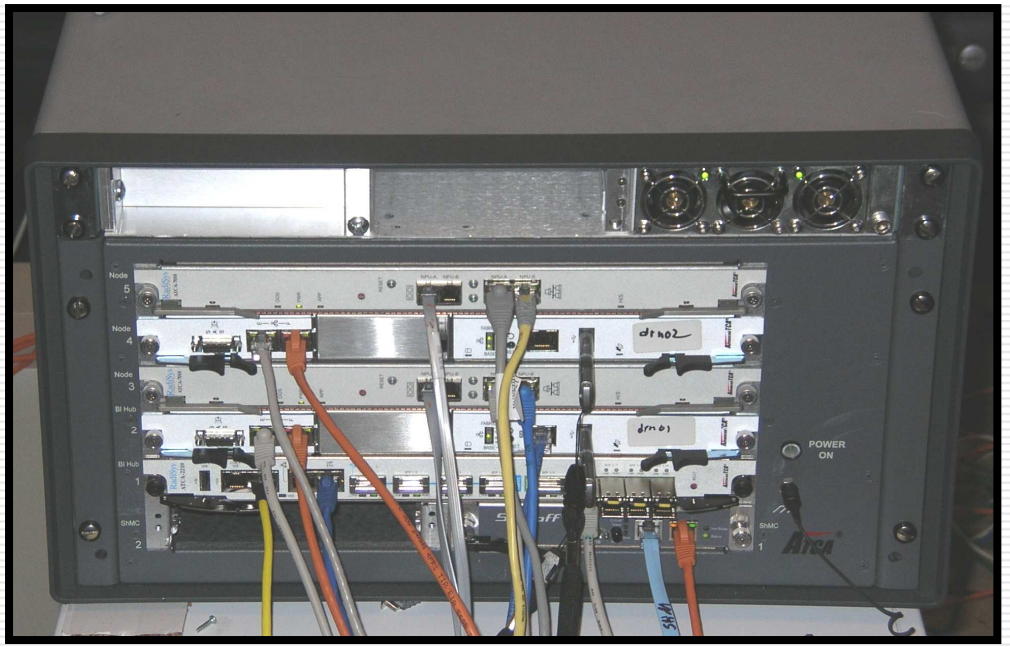
Our Motivation

- We build open, programmable routers, so we are interested in evaluating available technologies
  - » ATCA platform, network processors (NPs), general purpose processors, FPGAs, TCAMs, etc.



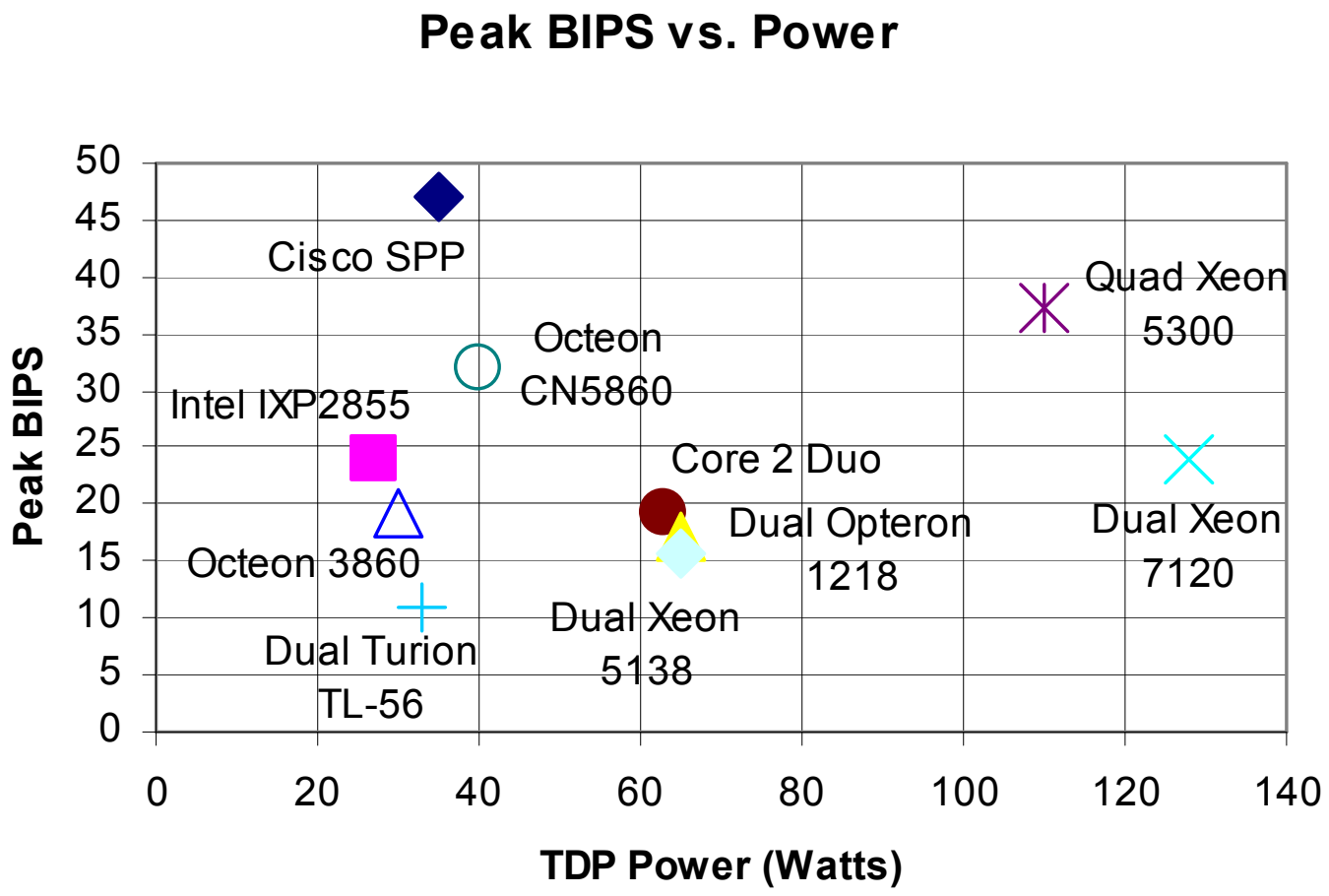
WU 5 slot ATCA Chassis

- **Question: Can we use general-purpose multi-core processors in place of networking-specific chips, like NPs and TCAMs?**
- Here, we compare NPs and general-purpose processors
  - » Quantitatively: peak BIPS, power, I/O BW, memory BW
  - » Qualitatively: software productivity, perf. evaluation

Multi-Core Processors

Processor	Clock (MHz)	CPU Power (W)	Chipset Power (W)	Packet I/O (Gb/s)	Mem I/O (Gb/s)	Processor Cores	Core Issue Width	Peak BIPS	Peak BIPS/W
Cisco SPP	250	35	0	192	175	188	1	47	1.34
Intel IXP2855	1500	27	0	25	121.6	16	1	24	0.89
Cavium Octeon CN5860	1000	40	0	25	102.4	16	2	32	0.80
Cavium Octeon CN3860	600	30	0	25	102.4	16	2	19.2	0.64
Intel Quad-Core Xeon 5300, Intel 5000P chipset	2330	80	30	0	85.6	4	4	37.28	0.34
AMD Turion 64 X2 Dual-Core Mobile TL-56	1800	33	0	51.2	85.6	2	3	10.8	0.33
Intel Mobile Core 2 Duo, Intel 965e chipset	2400	35	28	0	68	2	4	19.2	0.30
Intel Dual-Core Xeon 5138, Intel 5000P chipset	2130	35	30	0	85.6	2	4	17.04	0.26
AMD Dual-Core Opteron 1218 HE	2600	65	0	192	85.6	2	3	15.6	0.24
Intel Dual-Core Xeon 7120, Intel E8501 Chipset	3000	96	32	0	51.2	2	4	24	0.19

Peak Performance per Watt



Processor	Peak BIPS/W
Cisco SPP	1.34
Intel IXP2855	0.89
Cavium Octeon CN5860	0.80
Cavium Octeon CN3860	0.64
Intel Quad-Core Xeon 5300, Intel 5000P chipset	0.34
AMD Turion 64 X2 Dual-Core Mobile TL-56	0.33
Intel Mobile Core 2 Duo, Intel 965e chipset	0.30
Intel Dual-Core Xeon 5138, Intel 5000P chipset	0.26
AMD Dual-Core Opteron 1218 HE	0.24
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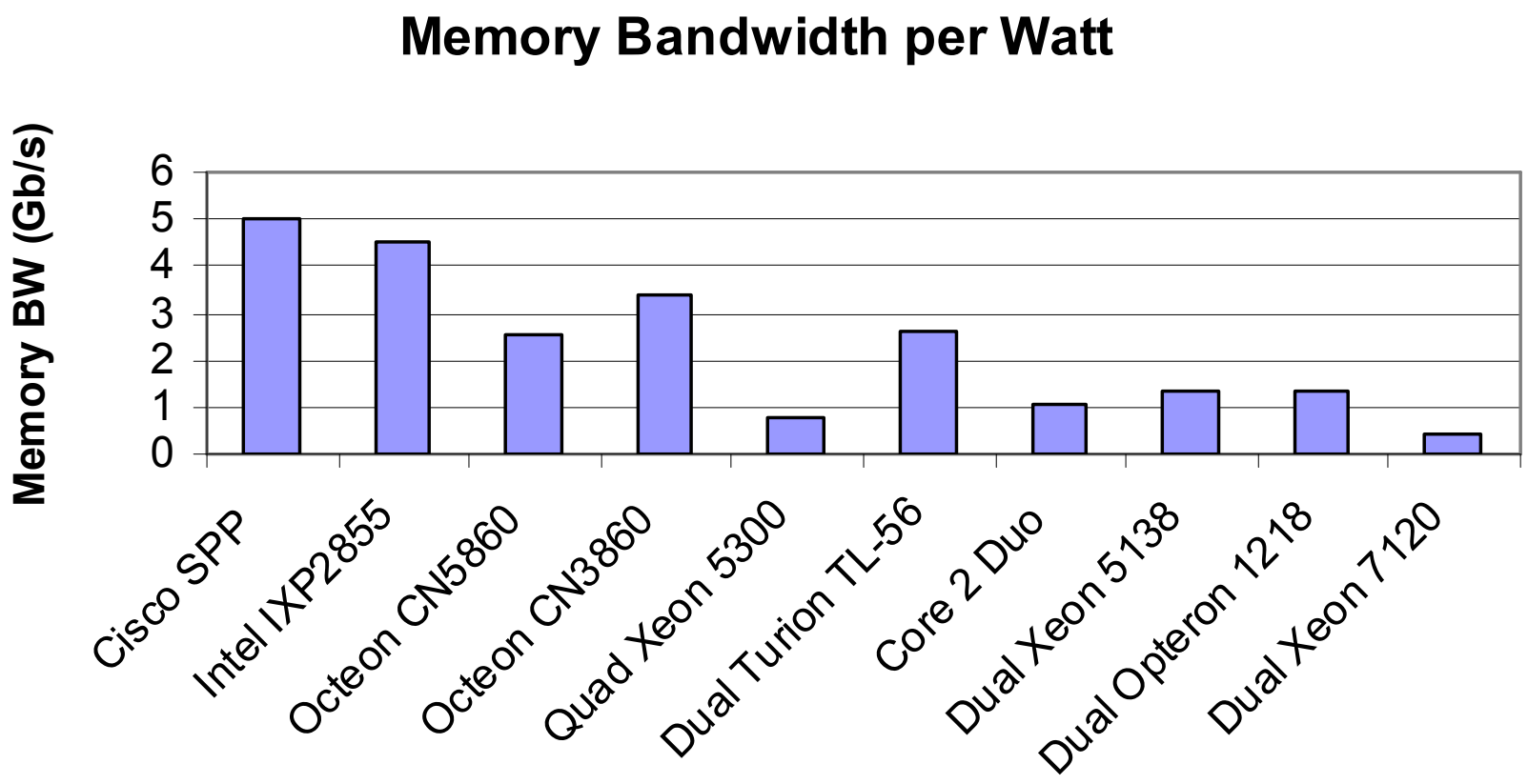
- NPs have > 2x greater BIPS/W

Memory Bandwidth per Watt



- NPs have > 2x greater Memory BW/W (exc. vs. Turion)

Qualitative Differences

- Benefits of general-purpose processors (in particular, x86-compatible)
  - »Substantial legacy software
  - »Many developers, mature development tools
  - »Large sales volumes ⇒ R&D, new chips every few months
- Benefits of networking-specific processors
  - »Application-specific power, performance and efficiency are design targets
  - »Programmer given low-level control of processor ⇒ performance guarantees, clear perf. evaluation

Conclusion

- Networking-specific multi-core processors have substantial advantages in:
  - Peak instruction throughput
  - Memory Bandwidth
  - Power efficiency
- Qualitative differences are not likely to change
  - Performance guarantees and optimization are difficult/impossible with general-purpose processors
- Look for general-purpose processors with these metrics
  - Peak BIPS/W ~ 1
  - Memory Bandwidth/W ~ 5 Gb/W