Entering the Petaflop Era: The Architecture and Performance of Roadrunner

Barker et al., 2008

TOP 10 Sites for June 2008

For more information about the sites and systems in the list, click on the links or view the complete list.

Rank	System	Cores	Rmax (TFlop/s)	Rpeak (TFlop/s)	Power (kW)
1	**Roadrunner** - BladeCenter QS22/LS21 Cluster, PowerXCell 8i 3.2 Ghz / Opteron DC 1.8 GHz, Voltaire Infiniband, IBM DOE/NNSA/LANL United States	122,400	1,026.00	1,375.78	2,345
2	**BlueGene/L** - eServer Blue Gene Solution, IBM DOE/NNSA/LLNL United States	212,992	478.20	596.38	2,329

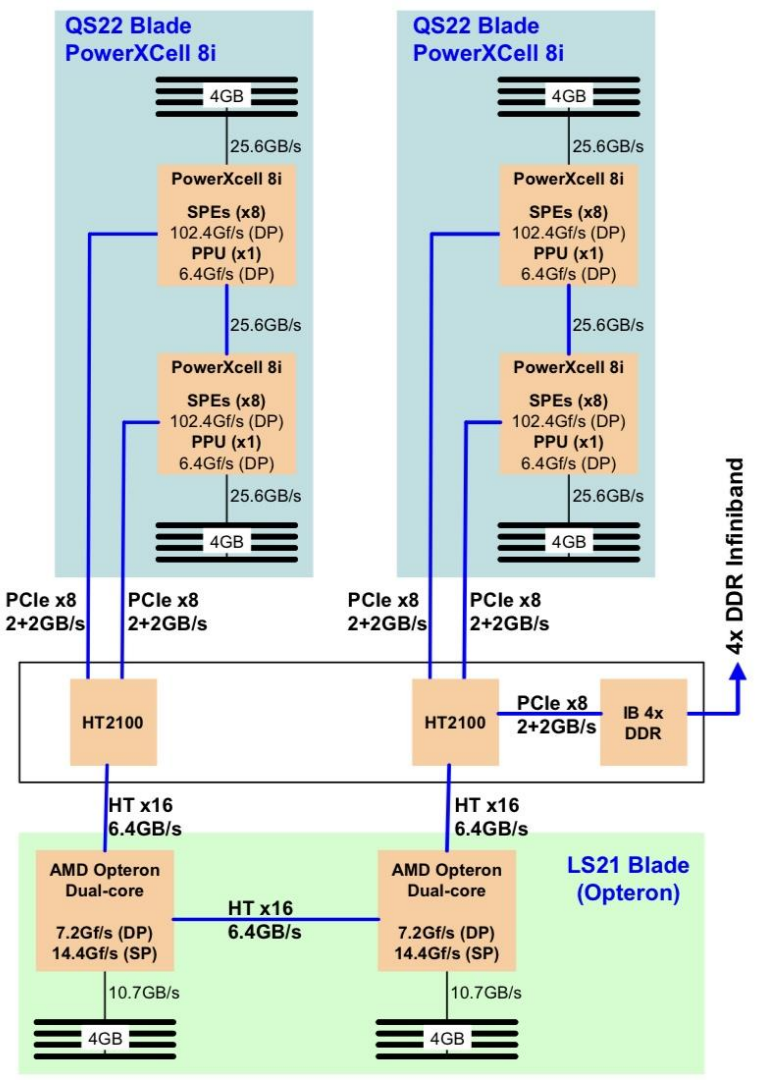
Petaflop Era

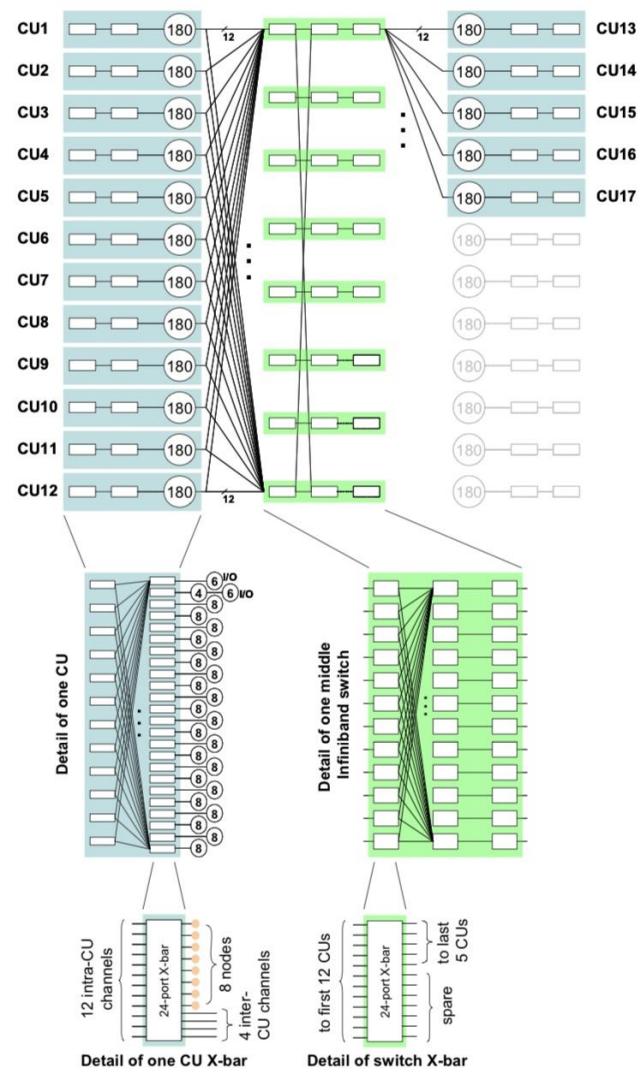
1 petaflop = 10^{15} floating-point operations per second


Roadrunner by IBM

Compute Node

- Hybrid-designed system
- 3,060 triblades
- **IBM PowerXCell 8i** (3.2 GHz, high-performing accelerator processor)
- Dual-core AMD Opteron (1.8 GHz, flexible microprocessor)





Compute Unit and System

TABLE I. SUMMARY OF THE DISTANCES BETWEEN NODE-0 (CU-1) AND ALL OTHER NODES (IN CROSSBAR HOPS) IN ROADRUNNER

Destination node	No. of destinations	Hop count
Self	1	0
Within same crossbar	7	1
Within same CU	172	3
In CUs 2-12, same crossbar	88	3
In CUs 2-12, different crossbar	1892	5
In CUs 13-17, same crossbar	40	5
In CUs 13-17, different crossbar	860	7
Total	3060	5.38 (average)

Case Study: Sweep3D

- Sweep3D on Roadrunner
- Good for showcasing the performance of Roadrunner
- Application designed to solve “neutron-transport problem”

How Sweep3D Uses Resources and Modifications to Original Program

- In a sense “sweeps” across nodes
- ‘Surface’ instead of ‘Volume’
- Used MPI with CML library
- Modifications improved performance

Results

- Compared processors alone and processors with Cell
- Performance improves by factor of 2
  - Even more for big machines
  - Even higher compared to Cell BE on double-precision

THANK YOU!

References

- Kevin J. Barker, Kei Davis, Adolfy Hoisie, Darren J. Kerbyson, Mike Lang, Scott Pakin, Jose C. Sancho. 2008. “Entering the Petaflop Era: The Architecture and Performance of Roadrunner”.
- November 2008. TOP500. (n.d.). https://www.top500.org/lists/top500/2008/11/