

Speed, Low Latency and Parallel Programming

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The Big Three

- MultiCore and ManyCore
 - Think Parallel is a skill and mindset
 - Lock/Wait Free codes require understanding
- Flash in the server
 - Super fast storage
 - Huge cheap memory footprint (TB's)
- RDMA Over Ethernet
 - Low Latency
 - High Throughput
 - Only way to keep up with data production rates

The Choices

- X86 CPUs
 - Programming skill is critical
 - Software is easier to maintain and evolve
- FPGA
 - Low Jitter
 - Hard to maintain and evolve
- GPU
 - Tools get better every day
 - Memory movement is still an issue
- MIC
 - Software leverage and lots of cores
 - Too new to know

Comparison of 1S and 2S Sandy Bridge 100M Message Parallel In-Memory SQL-92 Query

I7-3960X – 12 Cores @ 3.3 GHz with Turbo to 3.9 GHz

Operation	Elapsed Time	Matches/Sec/Core/GHz	Matches/Sec
1 Query	0.91 secs	2,309,842	115,228,131
20 Concurrent Queries	11.5 secs	8,147,440	182,361,040
Complete reindex (parse,write,match)	5.5 secs	194,830	19,065,018

E5-2680 – 32 Cores @ 2.7 with Turbo to 3.5 GHz

Operation	Elapsed Time	Matches/Sec/Core/GHz	Matches/Sec
1 Query	0.42 secs	2,229,115	249,660,952
20 Concurrent Queries	4.5 secs	8,141,100	466,033,760
Complete Reindex (parse,write,match)	2.3 secs	208,050	45,590,260

```

1  [|||||] 97.4%
2  [|||||] 98.0%
3  [|||||] 97.4%
4  [|||||] 96.1%
5  [|||||] 97.4%
6  [|||||] 96.7%
7  [|||||] 96.7%
8  [|||||] 96.7%
9  [|||||] 97.4%
10 [|||||] 96.7%
11 [|||||] 97.4%
12 [|||||] 96.7%
13 [|||||] 96.7%
14 [|||||] 98.0%
15 [|||||] 96.8%
16 [|||||] 96.7%
17 [|||||] 96.7%
18 [|||||] 98.0%
19 [|||||] 96.8%
20 [|||||] 96.8%
21 [|||||] 97.4%
22 [|||||] 96.7%
23 [|||||] 96.8%
24 [|||||] 97.4%
25 [|||||] 96.7%
26 [|||||] 97.4%
27 [|||||] 96.1%
28 [|||||] 97.4%
29 [|||||] 97.4%
30 [|||||] 96.7%
31 [|||||] 96.8%
32 [|||||] 96.7%
Mem [|||||] 29067/64382MB
Swp [|||||] 0/66431MB
    
```

Tasks: 72, 225 thr; 33 running
 Load average: 2.85 2.17 1.39
 Uptime: 1 day, 21:04:45

E5-2680 2.7-3.5 GHz

100M Message SQL-92 Query

20 Concurrent Queries

4.5 sec @ 466,033,760 matches/sec

PID	USER	PRI	NI	VIRT	RES	SHR	S	CPU%	MEM%	TIME+	Command
4973	jeff	20	0	46.3G	39.6G	12.5G	S	3049	63.0	1h35:27	/home/jeff/gfs/AMPS-3.0.3-RelWithDebInfo-develop-Linux/bin/ampServer config.xml
5025	jeff	20	0	46.3G	39.6G	12.5G	R	97.0	63.0	2:49.50	/home/jeff/gfs/AMPS-3.0.3-RelWithDebInfo-develop-Linux/bin/ampServer config.xml
5033	jeff	20	0	46.3G	39.6G	12.5G	R	96.0	63.0	2:56.09	/home/jeff/gfs/AMPS-3.0.3-RelWithDebInfo-develop-Linux/bin/ampServer config.xml
5016	jeff	20	0	46.3G	39.6G	12.5G	R	96.0	63.0	3:07.68	/home/jeff/gfs/AMPS-3.0.3-RelWithDebInfo-develop-Linux/bin/ampServer config.xml
5038	jeff	20	0	46.3G	39.6G	12.5G	R	96.0	63.0	2:49.49	/home/jeff/gfs/AMPS-3.0.3-RelWithDebInfo-develop-Linux/bin/ampServer config.xml
5037	jeff	20	0	46.3G	39.6G	12.5G	R	96.0	63.0	2:51.11	/home/jeff/gfs/AMPS-3.0.3-RelWithDebInfo-develop-Linux/bin/ampServer config.xml
5036	jeff	20	0	46.3G	39.6G	12.5G	R	96.0	63.0	2:52.28	/home/jeff/gfs/AMPS-3.0.3-RelWithDebInfo-develop-Linux/bin/ampServer config.xml
5041	jeff	20	0	46.3G	39.6G	12.5G	R	96.0	63.0	2:51.89	/home/jeff/gfs/AMPS-3.0.3-RelWithDebInfo-develop-Linux/bin/ampServer config.xml
5012	jeff	20	0	46.3G	39.6G	12.5G	R	96.0	63.0	2:52.21	/home/jeff/gfs/AMPS-3.0.3-RelWithDebInfo-develop-Linux/bin/ampServer config.xml
5017	jeff	20	0	46.3G	39.6G	12.5G	R	95.0	63.0	2:51.36	/home/jeff/gfs/AMPS-3.0.3-RelWithDebInfo-develop-Linux/bin/ampServer config.xml
5040	jeff	20	0	46.3G	39.6G	12.5G	R	95.0	63.0	2:48.81	/home/jeff/gfs/AMPS-3.0.3-RelWithDebInfo-develop-Linux/bin/ampServer config.xml
5022	jeff	20	0	46.3G	39.6G	12.5G	R	95.0	63.0	2:49.36	/home/jeff/gfs/AMPS-3.0.3-RelWithDebInfo-develop-Linux/bin/ampServer config.xml
5027	jeff	20	0	46.3G	39.6G	12.5G	R	95.0	63.0	2:49.68	/home/jeff/gfs/AMPS-3.0.3-RelWithDebInfo-develop-Linux/bin/ampServer config.xml
5021	jeff	20	0	46.3G	39.6G	12.5G	R	95.0	63.0	2:51.31	/home/jeff/gfs/AMPS-3.0.3-RelWithDebInfo-develop-Linux/bin/ampServer config.xml
5032	jeff	20	0	46.3G	39.6G	12.5G	R	95.0	63.0	2:51.84	/home/jeff/gfs/AMPS-3.0.3-RelWithDebInfo-develop-Linux/bin/ampServer config.xml
5029	jeff	20	0	46.3G	39.6G	12.5G	R	95.0	63.0	2:51.96	/home/jeff/gfs/AMPS-3.0.3-RelWithDebInfo-develop-Linux/bin/ampServer config.xml

The Takeaway

- Exploit parallelism in any way possible
- Pick the solution that works best for you whether it be CPUs, FPGAs or GPUs
- The trade offs depend on what you are trying to achieve, low jitter vs ease of change
- Design and plan for even more parallelism than you have today, i.e. forward scaling
- Invest in experimentation and don't rely on past knowledge