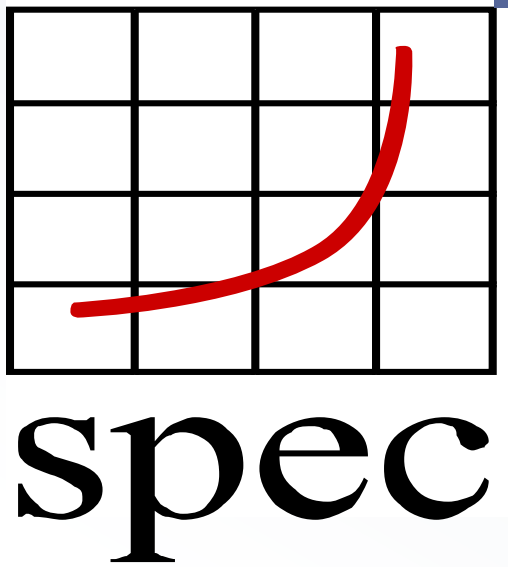
How to interpret and compare SPEC benchmark results

Swen Boehm, Mayara Gimenes, Robert Henschel,
Veronica G. Vergara Larrea, Junjie Li, Sandra Wienke



https://www.spec.org/hpg/publications

http://pages.iu.edu/~lijunj/sc19

Contents

Contents

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  - Basis of comparison is disclosed (if applicable) (e.g. my result is 20% faster than xxx)

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SPEC Score

- SPEC Score = geometric mean of all benchmark component ratios
- "Ratio" means: $\frac{\text{runtime on reference machine (given)}}{\text{median(runtime of your measurement)}}$
  - SPEC Score of reference machine is "1"
- Reference machines
  - For SPEC OMP2012
    - Sun Fire X4140, 2xAMD Opteron 2384, 8 cores, 2 chips, 4 cores/chip, 2.7 GHz
  - For SPEC Accel
    - SGI C3108-TY11, NVIDIA Tesla C2070, Intel Xeon E5620 2.4GHz

➢Higher is better

Results - http://spec.org/accel/results/accel.html

OpenACC (26):

Test Sponsor	System Name	Accelerator Name	Results		Energy	
			Base	Peak	Base	Peak
Indiana University	Cray XC30 HTML | CSV | Text | PDF | PS | Config	Intel Xeon E5-2697 v2	1.18	Not Run	--	--
Indiana University	Cray XK7 HTML | CSV | Text | PDF | PS | Config	NVIDIA Tesla K20	1.71	Not Run	--	--
Indiana University	Cray XK7 HTML | CSV | Text | PDF | PS | Config	NVIDIA Tesla K20	1.78	Not Run	--	--
Indiana University	Cray XK7 HTML | CSV | Text | PDF | PS | Config	NVIDIA Tesla K20	2.00	Not Run	--	--
Indiana University	Cray XK7 HTML | CSV | Text | PDF | PS | Config	NVIDIA Tesla K20	2.01	Not Run	--	--
Indiana University	Cray XK7 HTML | CSV | Text | PDF | PS | Config	NVIDIA Tesla K20	2.07	Not Run	--	--
Indiana University	HP Z820 Workstation HTML | CSV | Text | PDF | PS | Config	Intel Xeon E5-2640 v2	0.662	Not Run	1.10	--
⋮						
NVIDIA Corporation	IBM Power Systems AC922 for High Performance Computing (8335-GTH) HTML | CSV | Text | PDF | PS | Config	Tesla V100	11.9	11.9	--	--
Test Sponsor	**System Name**	**Accelerator Name**	**Results**		**Energy**	
			Base	**Peak**	**Base**	**Peak**
Oak Ridge National Laboratory	IBM POWER8 S822LC HTML | CSV | Text | PDF | PS | Config	NVIDIA Tesla P100	8.25	Not Run	--	--
Oak Ridge National Laboratory	Cray XK7 system HTML | CSV | Text | PDF | PS | Config	NVIDIA Tesla K20X	2.26	Not Run	--	--

SPEC Score

graphical representation

config file

as of 11/2019

SPEC Score

- Lets take a look at **base vs. peak**: 
- https://www.spec.org/accel/results/res2017q3/accel-20170726-00092.html
- or go to Accel OpenMP results and search the entries for “LADMP00AP” (“system”), pick the result (“html”) from “Technische Universitaet Dresden”

- Lets take a look at **energy**: 
- http://spec.org/accel/results/res2017q2/accel-20170515-00073.html
- or go to Accel OpenMP results and search the page for “Pedestal”, pick the second result (“html”)

Note: This result is from SPEC Accel v1.1. Current version is v1.2. For demonstration purposes, this is fine!

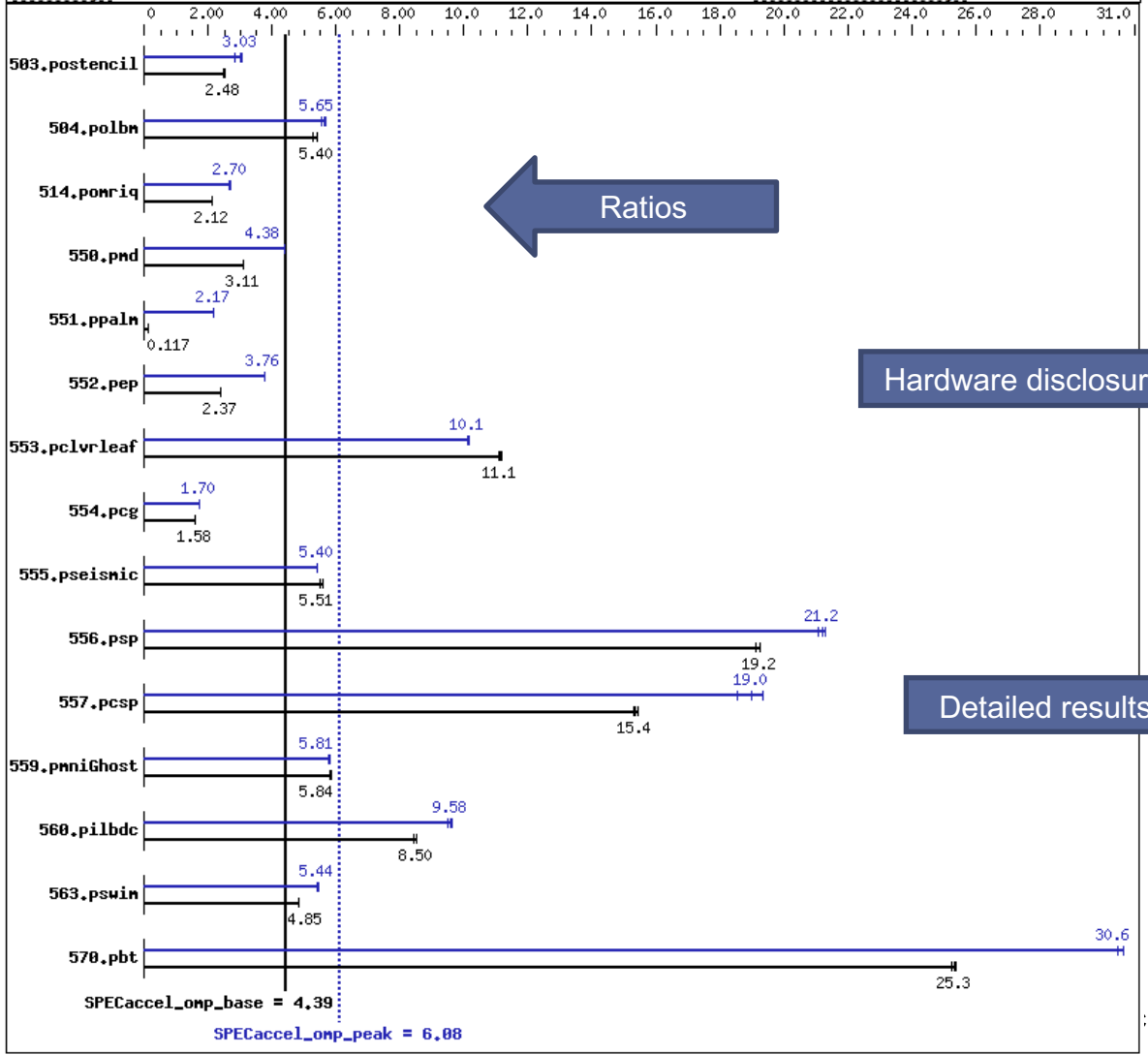
SPEC® ACCEL™ OMP Result

Intel (Test Sponsor: Technische Universitaet Dresden)
Intel Xeon Phi 7210
Intel Server System LADMP00AP Family (Xeon Phi 7210, 1.3 GHz, 64 cores, 4 threads)

SPECaccel_omp_base = 4.39
SPECaccel_omp_peak = 6.08

ACCEL license: 37A
Test sponsor: Technische Universitaet Dresden
Tested by: Technische Universitaet Dresden

Test date: Jul-2017
Hardware Availability: Jun-2016
Software Availability: Dec-2016



Metircs

Ratios

Hardware disclosure

Detailed results

SPEC Score: base vs. peak *(backup)*

Hardware

Maximum:
FPU: None
CPU(s) enabled: 64 cores, 1 chip, 64 cores/chip, 4 threads/core
CPU(s) orderable: 1 chip
Primary Cache: 32 KB I + 32 KB D on chip per core
Secondary Cache: 1 MB I+D on chip per 2 cores
L3 Cache: 16 GB I+D on chip per chip
Other Cache: None
Memory: 96 GB (6 x 16 GB 2Rx4 PC4-2400T-R, running at 1066 MHz)
Disk Subsystem: 275 GB INTEL SSDSC2BB30
Other Hardware: --

Accelerator

el Model e: Xeon Phi 7210
el Vendor: Intel
el Name: Intel Xeon Phi 7210
e of Accel: CPU
Accel Connection: N/A
Does Accel Use ECC: yes
Accel Description: Intel Xeon Phi 7210, SMT ON, Turbo ON
Cluster Mode: Quadrant, Memory Mode: Cache
Accel Driver:

Software

Operating System: CentOS Linux release 7.3 3.10.0-514.21.2.el7.x86_64
Compiler: Intel Compiler C/C++/Fortran Version 17.0.1 20161005
File System: ext4
System State: Run level 3 (user-level)
Other Software: FFTW 3.3.6pl1

Results Table

Benchmark	Base						Peak					
	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio
503.postencil	**43.9**	**2.48**	44.1	2.47	43.3	2.51	35.9	3.04	38.6	2.82	**36.0**	**3.03**
504.polbm	23.1	5.27	**22.6**	**5.40**	22.5	5.42	**21.6**	**5.65**	22.1	5.52	21.5	5.67
514.pomriq	294	2.11	**293**	**2.12**	291	2.13	233	2.67	230	2.70	**230**	**2.70**
550.pmd	77.9	3.09	**77.5**	**3.11**	77.4	3.12	**55.0**	**4.38**	55.1	4.38	54.9	4.39
551.ppalm	4660	0.117	**4654**	**0.117**	4645	0.117	**251**	**2.17**	251	2.17	252	2.16
552.pep	**97.4**	**2.37**	97.4	2.37	97.5	2.37	61.6	3.75	61.4	3.76	**61.5**	**3.76**
553.pclvrleaf	**103**	**11.1**	102	11.2	103	11.1	113	10.1	113	10.2	**113**	**10.1**
554.pcg	210	1.59	**211**	**1.58**	212	1.57	195	1.71	**195**	**1.70**	195	1.70
555.pseismic	50.6	5.57	**51.2**	**5.51**	51.3	5.50	52.2	5.41	**52.3**	**5.40**	52.3	5.39
556.psp	**42.5**	**19.2**	42.5	19.3	42.8	19.1	38.8	21.1	38.4	21.3	**38.6**	**21.2**
557.pcsp	56.1	15.3	55.6	15.4	**55.9**	**15.4**	46.3	18.5	44.4	19.3	**45.3**	**19.0**
559.pmniGhost	**68.0**	**5.84**	67.9	5.85	68.4	5.80	**68.4**	**5.81**	68.3	5.81	68.7	5.78
560.pilbdc	76.6	8.53	**76.8**	**8.50**	77.7	8.41	**68.1**	**9.58**	67.8	9.63	68.8	9.49
563.pswim	**32.8**	**4.85**	32.9	4.83	32.8	4.85	29.4	5.41	29.1	5.46	**29.2**	**5.44**
570.pbt	**30.8**	**25.3**	30.7	25.4	30.9	25.2	25.5	30.6	**25.5**	**30.6**	25.6	30.5

Results appear in the order in which they were run. Bold underlined text indicates a median measurement.

: Interp

SPEC® ACCEL™ OMP Result

Intel (Test Sponsor: Technische Universitaet Dresden)
Intel Xeon Phi 7210
Intel Server System LADMP00AP Family (Xeon Phi 7210, 1.3 GHz, 64 cores, 4 threads)

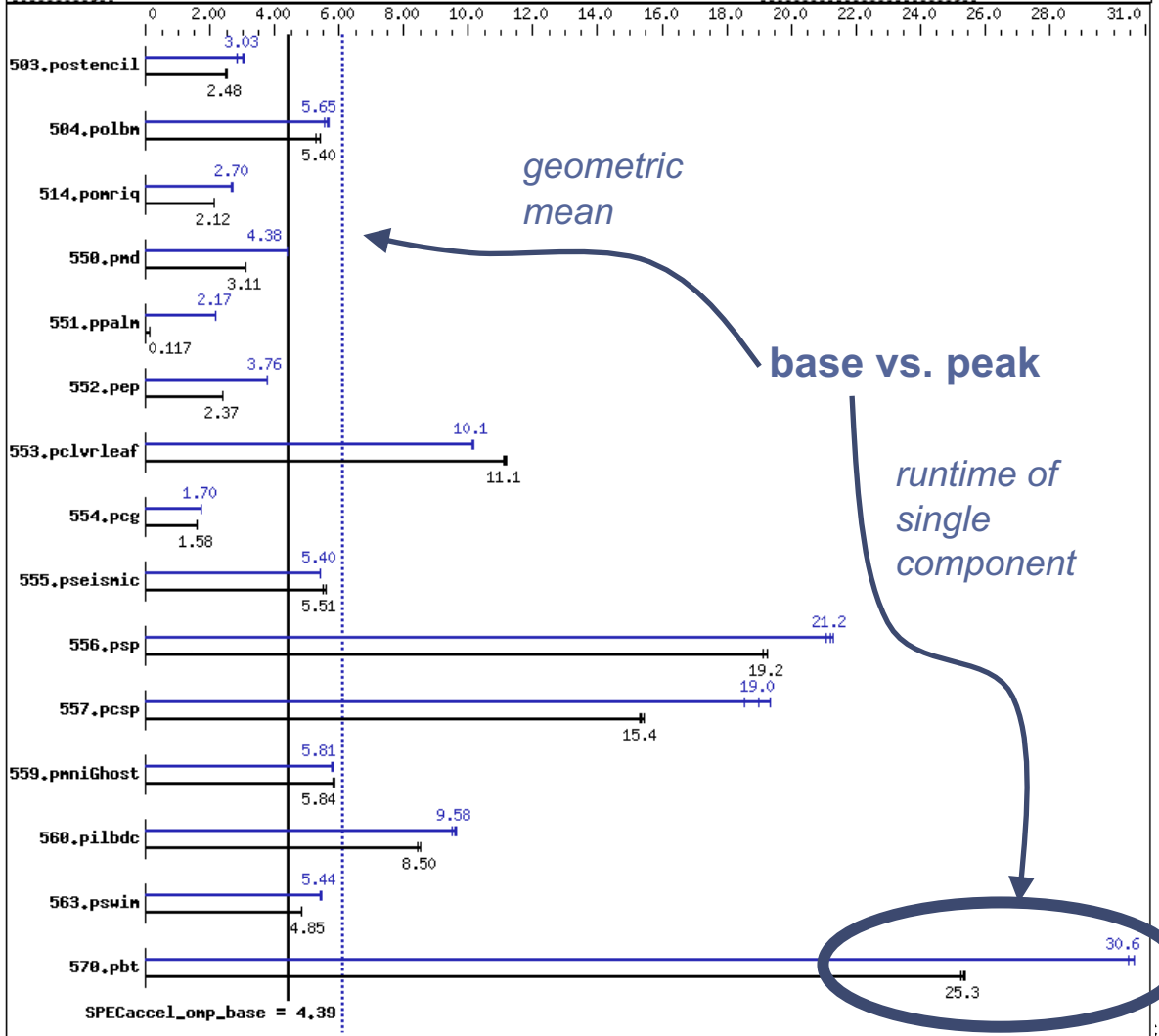
SPECaccel_omp_base = 4.39

SPECaccel_omp_peak = 6.08

SPEC score

ACCEL license: 37A
Test sponsor: Technische Universitaet Dresden
Tested by: Technische Universitaet Dresden

Test date: Jul-2017
Hardware Availability: Jun-2016
Software Availability: Dec-2016



: Interp

SPEC Score: base vs. peak *(backup)*

geometric mean

base vs. peak

runtime of single component

median

Hardware

Maximum:	
FPU:	None
CPU(s) enabled:	64 cores, 1 chip, 64 cores/chip, 4 threads/core
CPU(s) orderable:	1 chip
Primary Cache:	32 KB I + 32 KB D on chip per core
Secondary Cache:	1 MB I+D on chip per 2 cores
L3 Cache:	16 GB I+D on chip per chip
Other Cache:	None
Memory:	96 GB (6 x 16 GB 2Rx4 PC4-2400T-R, running at 1066 MHz)
Disk Subsystem:	275 GB INTEL SSDSC2BB30
Other Hardware:	--

Accelerator

el Model e:	Xeon Phi 7210
el Vendor:	Intel
el Name:	Intel Xeon Phi 7210
e of Accel:	CPU
Accel Connection:	N/A
Does Accel Use ECC:	yes
Accel Description:	Intel Xeon Phi 7210, SMT ON, Turbo ON Cluster Mode: Quadrant, Memory Mode: Cache
Accel Driver:	

Software

Operating System:	CentOS Linux release 7.3 3.10.0-514.21.2.el7.x86_64
Compiler:	Intel Compiler C/C++/Fortran Version 17.0.1 20161005
File System:	ext4
System State:	Run level 3 (user-level)
Other Software:	FFTW 3.3.6pl1

Results Table

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514.pomriq	294	2.11	**293**	**2.12**	291	2.13	233	2.67	230	2.70	**230**	**2.70**
550.pmd	77.9	3.09	**77.5**	**3.11**	77.4	3.12	**55.0**	**4.38**	55.1	4.38	54.9	4.39
551.ppalm	4660	0.117	**4654**	**0.117**	4645	0.117	**251**	**2.17**	251	2.17	252	2.16
552.pep	**97.4**	**2.37**	97.4	2.37	97.5	2.37	61.6	3.75	61.4	3.76	**61.5**	**3.76**
553.pclvrleaf	**103**	**11.1**	102	11.2	103	11.1	113	10.1	113	10.2	**113**	**10.1**
554.pcg	210	1.59	**211**	**1.58**	212	1.57	195	1.71	**195**	**1.70**	195	1.70
555.pseismic	50.6	5.57	**51.2**	**5.51**	51.3	5.50	52.2	5.41	**52.3**	**5.40**	52.3	5.39
556.psp	**42.5**	**19.2**	42.5	19.3	42.8	19.1	38.8	21.1	38.4	21.3	**38.6**	**21.2**
557.pcsp	56.1	15.3	55.6	15.4	**55.9**	**15.4**	46.3	18.5	44.4	19.3	**45.3**	**19.0**
559.pmniGhost	**68.0**	**5.84**	67.9	5.85	68.4	5.80	**68.4**	**5.81**	68.3	5.81	68.7	5.78
560.pilbdc	76.6	8.53	**76.8**	**8.50**	77.7	8.41	**68.1**	**9.58**	67.8	9.63	68.8	9.49
563.pswin	**32.8**	**4.85**	32.9	4.83	32.8	4.85	29.4	5.41	29.1	5.46	**29.2**	**5.44**
570.pbt	**30.8**	**25.3**	30.7	25.4	30.9	25.2	25.5	30.6	**25.5**	**30.6**	25.6	30.5

Results appear in the order in which they were run. Bold underlined text indicates a median measurement.

SPEC Score: base vs. peak *(backup)*

Base Compiler Invocation

C benchmarks:

icc

Fortran benchmarks:

ifort

Benchmarks using both Fortran and C:

icc ifort

Base Portability Flags

503.postencil: -DSPEC_USE_INNER_SIMD
504.polbm: -DSPEC_USE_INNER_SIMD
514.pomriq: -DSPEC_USE_INNER_SIMD
550.pmd: -DSPEC_USE_INNER_SIMD -80
551.ppalm: -DSPEC_USE_INNER_SIMD
552.pep: -DSPEC_USE_INNER_SIMD
553.pclvrleaf: -DSPEC_USE_INNER_SIMD
554.pcg: -DSPEC_USE_INNER_SIMD
555.pseismic: -DSPEC_USE_INNER_SIMD
556.psp: -DSPEC_USE_INNER_SIMD
557.pcsp: -DSPEC_USE_INNER_SIMD
559.pmniGhost: -DSPEC_USE_INNER_SIMD -nofor_main
560.pilbdc: -DSPEC_USE_INNER_SIMD
563.pswim: -DSPEC_USE_INNER_SIMD
570.pbt: -DSPEC_USE_INNER_SIMD

Base Optimization Flags

C benchmarks:

-O3 -g -qopenmp -xMIC-AVX512 -qopenmp-offload=host

all the same

Fortran benchmarks:

-O3 -g -qopenmp -xMIC-AVX512 -qopenmp-offload=host

Benchmarks using both Fortran and C:

-O3 -g -qopenmp -xMIC-AVX512 -qopenmp-offload=host

Peak Compiler Invocation

C benchmarks:

nd C:

Peak Portability Flags

503.postencil: -DSPEC_USE_INNER_SIMD
504.polbm: -DSPEC_USE_INNER_SIMD
514.pomriq: -DSPEC_USE_INNER_SIMD
550.pmd: -DSPEC_USE_INNER_SIMD -80
551.ppalm: -DSPEC_USE_INNER_SIMD -DSPEC_HOST_FFTW3
552.pep: -DSPEC_USE_INNER_SIMD
553.pclvrleaf: -DSPEC_USE_INNER_SIMD
554.pcg: -DSPEC_USE_INNER_SIMD
555.pseismic: -DSPEC_USE_INNER_SIMD
556.psp: -DSPEC_USE_INNER_SIMD
557.pcsp: -DSPEC_USE_INNER_SIMD
559.pmniGhost: -DSPEC_USE_INNER_SIMD -nofor_main
560.pilbdc: -DSPEC_USE_INNER_SIMD
563.pswim: -DSPEC_USE_INNER_SIMD
570.pbt: -DSPEC_USE_INNER_SIMD

Peak Optimization Flags

C benchmarks:

503.postencil: -O3 -xCORE-AVX2 -g -qopenmp -qopenmp-offload=host -qopt-prefetch=3

504.polbm: -O3 -xMIC-AVX512 -g -qopenmp -qopenmp-offload=host -qopt-prefetch=5

514.pomriq: -O3 -xMIC-AVX512 -g -qopenmp -qopenmp-offload=host -qopt-prefetch=2

552.pep: -O3 -xMIC-AVX512 -g -qopenmp -qopenmp-offload=host -qopt-streaming-stores always

554.pcg: -O3 -xCORE-AVX2 -g -qopenmp -qopenmp-offload=host -qopt-prefetch=2 -qopt-streaming-stores always

557.pcsp: Same as 504.polbm

570.pbt: -O3 -xMIC-AVX512 -g -qopenmp -qopenmp-offload=host

may be different per benchmark component

-qopenmp -qopenmp-offload=host -qopt-prefetch=3 -no-prec-div

-qopenmp -qopenmp-offload=host -no-prec-sqrt
3.6pl1-gcc5.3-intelmpi5.1/include
-L/sw/taurus/libraries/fftw/3.3.6pl1-gcc5.3-intelmpi5.1/lib

555.pseismic: -O3 -xMIC-AVX512 -g -qopenmp -qopenmp-offload=host

556.psp: -O -xMIC-AVX512 -g -qopenmp -qopenmp-offload=host -qopt-prefetch=2

560.pilbdc: -O -xMIC-AVX512 -g -qopenmp -qopenmp-offload=host -qopt-prefetch=3

563.pswim: ame as 555.pseismic

Benchmarks using both Fortran and C:

553.pclvrleaf: -O3 -xMIC-AVX512 -g -qopenmp -qopenmp-offload=host -qopt-streaming-stores always

559.pmniGhost: -O3 -xMIC-AVX512 -g -qopenmp -qopenmp-offload=host -qopt-prefetch=3 -qopt-streaming-stores always

shing SPEC results

SPEC Score: base vs. peak (

SPEC Score: base vs. peak
(backup)

Results appear in the order in which they were run. Bold underlined text indicates a median measurement.

Submit Notes

```
The config file option 'submit' was used.
submit = numactl -p 0 $command
```

Platform Notes

```
Sysinfo program /tmp/spec-accel/1.2/Docs/sysinfo
$Rev: 6965 $ $Date:: 2015-04-21 #$ c05a7f14b1b1765e3fe1df68447e8a35
running on taurusknl28.taurus.hrsk.tu-dresden.de Mon Jul 24 10:45:36 2017

This section contains SUT (System Under Test) info as seen by
some common utilities.  To remove or add to this section, see:
  http://www.spec.org/accel/Docs/config.html#sysinfo

From /proc/cpuinfo
   model name : Intel(R) Xeon Phi(TM) CPU 7210 @ 1.30GHz
      1 "physical id"s (chips)
      256 "processors"
   cores, siblings (Caution: counting these is hw and system dependent.  The
   following excerpts from /proc/cpuinfo might not be reliable.  Use with
   caution.)
      cpu cores : 64
      siblings  : 256
      physical 0: cores 0 1 2 3 6 7 10 11 12 13 14 15 18 19 20 21 22 23 24 25 26
      27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51
      52 53 56 57 58 59 60 61 62 63 64 65 68 69 70 71 72 73
   cache size : 1024 KB

From /proc/meminfo
   MemTotal:       98707216 kB
   HugePages_Total:       0
   Hugepagesize:       2048 kB

/usr/bin/lsb_release -d
   CentOS Linux release 7.3.1611 (Core)

From /etc/*release* /etc/*version*
   centos-release: CentOS Linux release 7.3.1611 (Core)
   centos-release-upstream: Derived from Red Hat Enterprise Linux 7.3 (Source)
   os-release:
      NAME="CentOS Linux"
      VERSION="7 (Core)"
      ID="centos"
      ID_LIKE="rhel fedora"
      VERSION_ID="7"
      PRETTY_NAME="CentOS Linux 7 (Core)"
      ANSI_COLOR="0;31"
      CPE_NAME="cpe:/o:centos:centos:7"
   redhat-release: CentOS Linux release 7.3.1611 (Core)
   system-release: CentOS Linux release 7.3.1611 (Core)
   system-release-cpe: cpe:/o:centos:centos:7

uname -a:
   Linux taurusknl28.taurus.hrsk.tu-dresden.de 3.10.0-514.21.2.el7.x86_64 #1 SMP
   Tue Jun 20 12:24:47 UTC 2017 x86_64 x86_64 x86_64 GNU/Linux

run-level 3 Jun 30 13:46

SPEC is set to: /tmp/spec-accel/1.2
   Filesystem     Type  Size  Used Avail Use% Mounted on
   /dev/sda1      ext4  275G  6.5G  255G   3% /
Additional information from dmidecode:

   Warning: Use caution when you interpret this section. The 'dmidecode' program
   reads system data which is "intended to allow hardware to be accurately
   determined", but the intent may not be met, as there are frequent changes to
   hardware, firmware, and the "DMTF SMBIOS" standard.


(End of data from sysinfo program)
```

General Notes

```
Used Environment Variables:
  ENV_KMP_AFFINITY=compact,0 - assign OpenMP Threads continously
  ENV_OMP_NUM_THREADS=128 - limits number of Threads to be started to 128
  ENV_KMP_HW_SUBSET=1S,64C,2T - control Thread distribution accross sockets, cores and hw threads
  ENV_FORT_BUFFERED=true - enables buffered I/O for Fortran
  ENV_OMP_DYNAMIC -     Enable or disable the dynamic adjustment of the number of threads within a te
  ENV_KMP_LIBRARY - Selects the OpenMP runtime library throughput. The options for the variable value
  ENV_KMP_BLOCKTIME - Sets the time, in milliseconds, that a thread should wait, after completing the
```

SPEC Score: energy (backup)

SPEC® ACCEL™ OMP Result

energy score

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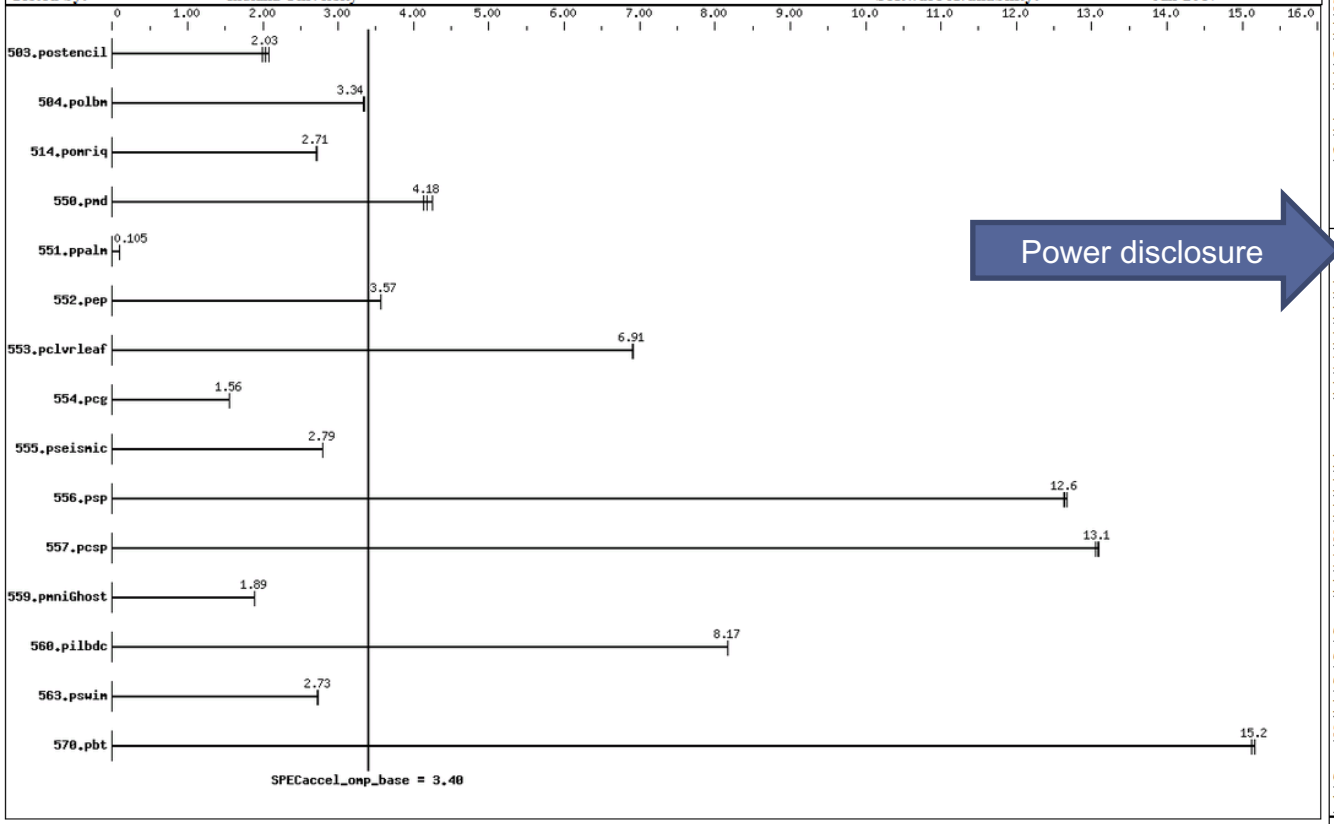
Colfax International (Test Sponsor: Indiana University)
Xeon Phi 7210
Ninja Developer Platform Pedestal: Liquid Cooled

SPECaccel_omp_base =	3.40
SPECaccel_omp_energy_base =	4.54
SPECaccel_omp_peak =	Not Run
SPECaccel_omp_energy_peak =	--

ACCEL license:	3440A	**Test date:**	May-2017
Test sponsor:	Indiana University	**Hardware Availability:**	Aug-2016
Tested by:	Indiana University	**Software Availability:**	Jan-2017



Power disclosure

Hardware

CPU Name:	Intel Xeon Phi 7210
CPU Characteristics:	Simultaneous multithreading (SMT) on, Turbo off.
CPU MHz:	1300
CPU MHz Maximum:	1300
FPU:	Integrated
CPU(s) enabled:	64 cores, 1 chip, 64 cores/chip, 4 threads/core
CPU(s) orderable:	1 to 1 chip
Primary Cache:	32 KB I + 32 KB D on chip per core
Secondary Cache:	1 MB I+D on chip per tile (2 cores)
L3 Cache:	None
Other Cache:	None
Memory:	96 GB (6 x 16 GB 2Rx8 PC4-2400T-REB-11, ECC) + 16 GB MCDRAM
Disk Subsystem:	Intel S3510 SSD 800GB, SATA3
Other Hardware:	None

Accelerator

Accel Model Name:	Xeon Phi 7210
Accel Vendor:	Intel
Accel Name:	Xeon Phi 7210
Type of Accel:	CPU
Accel Connection:	N/A
Does Accel Use ECC:	Yes
Accel Description:	Second generation Xeon Phi self-bootable CPU, SMT on, Turbo off, flat DDR4+MCDRAM
Accel Driver:	N/A

Software

Operating System:	CentOS Linux release 7.2.1511 (Core) 3.10.0-327.13.1.el7.xppsl_1.3.3.151.x86_64
Compiler:	Intel Parallel Studio XE 2017 Update 1 for Linux, Version 17.0.1.132 Build 20161005
File System:	ext4
System State:	Run level 3 (multi-user with networking)
Other Software:	None

Power

Power Supply:	750W
Power Supply Details:	Seasonic SSR-750RM Active PFC F3
Max. Power (W):	286.39
Idle Power (W):	91.01
Min. Temperature (C):	21.69

Power Analyzer

Power Analyzer:	156.56.179.146:8888
Hardware Vendor:	ZES Zimmer
Model:	ZES LMG450:4-Channel
Serial Number:	01001849
Input Connection:	RS232 USB adapter
Metrology Institute:	NIST (National Institute of Standards and Technology)
Calibration By:	ZES Zimmer
Calibration Label:	3783190001e
Calibration Date:	02.20.2017
PTDaemon Version:	1.8.1 (a497ea15; 2016-12-20)
Setup Description:	connected to the single power supply that powers the system
Current Ranges Used:	0.0A
Voltage Range Used:	130V

Temperature Meter

Temperature Meter:	156.56.179.146:8889
Hardware Vendor:	Digi
Model:	Watchport/H
Serial Number:	W40236768
Input Connection:	USB
PTDaemon Version:	1.8.1 (a497ea15; 2016-12-20)
Setup Description:	positioned in front of intake fan

Contents

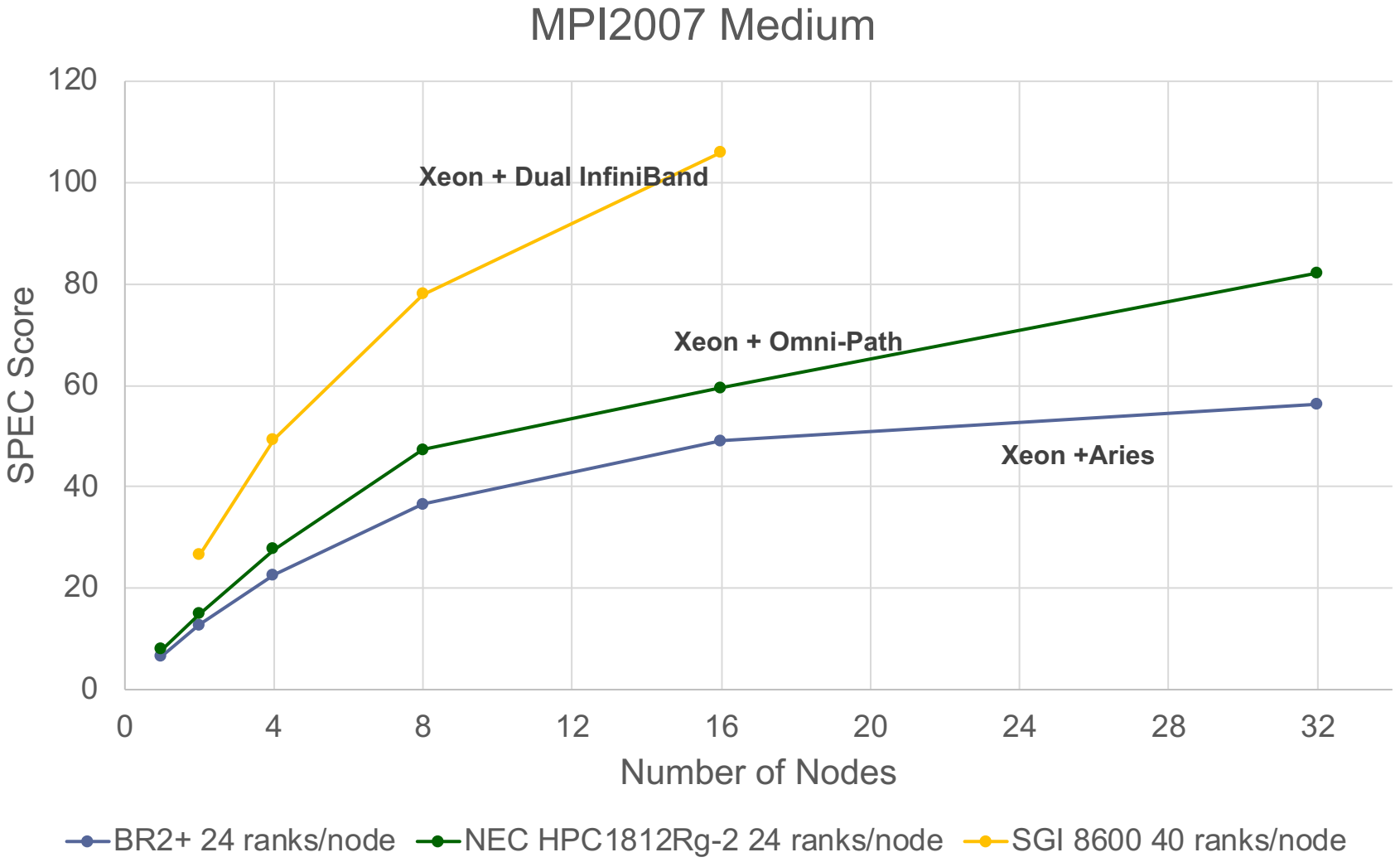
Comparing Results

- For both SPEC OpenMP2012 and SPEC MPI2007, most results are part of a scalability or comparison study.
  - Increasing MPI ranks
  - Testing different compilers
  - ...

- The next charts are created from published results!
- Take a look online.... 

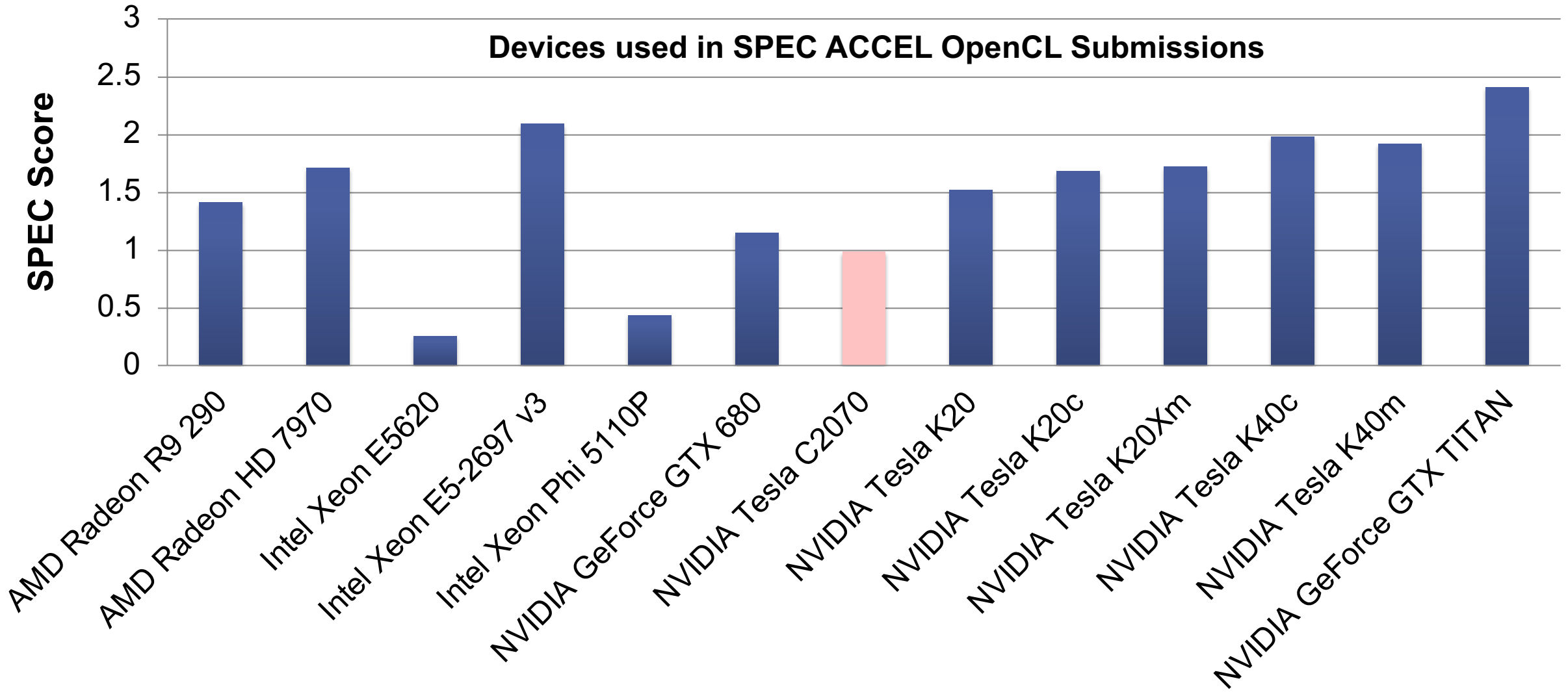
- Note that you cannot compare results between versions or between data sets!

System and Interconnect Comparison

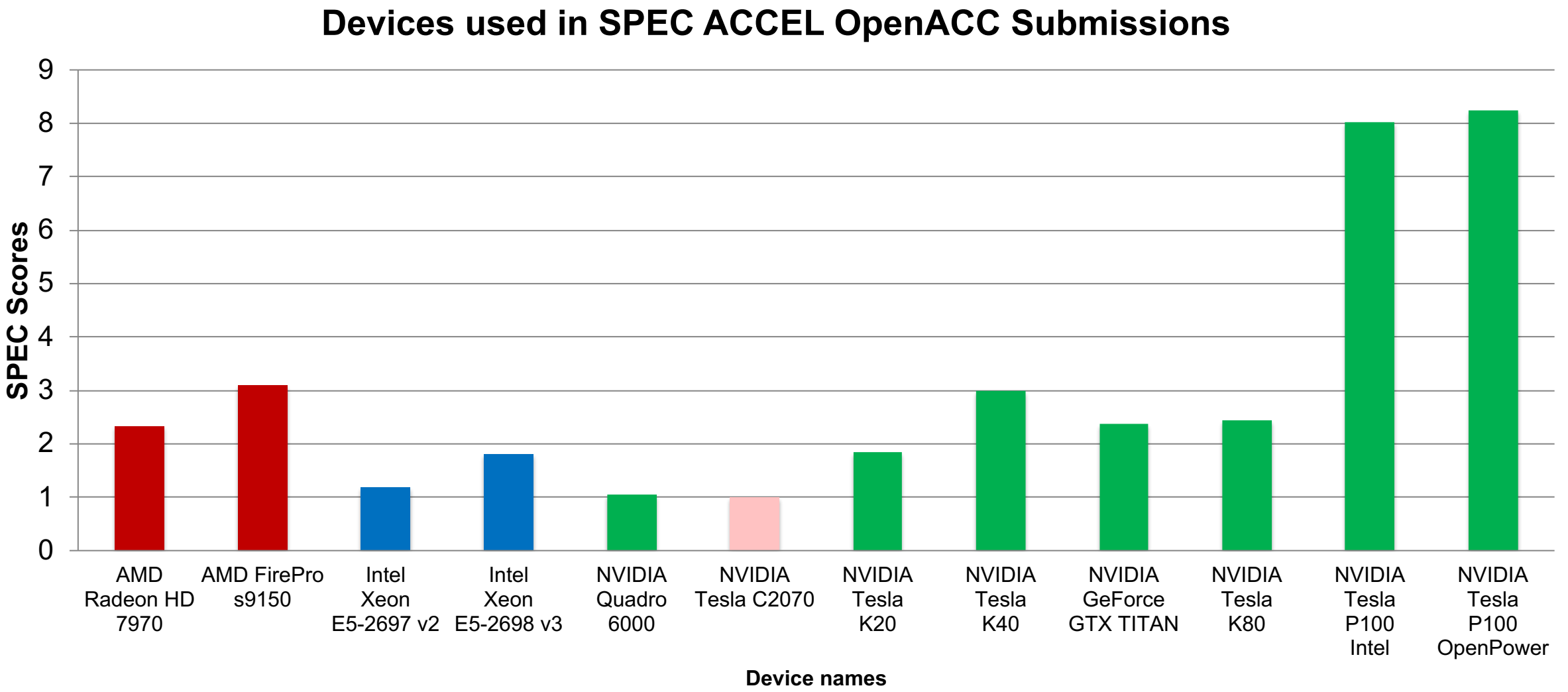


- Cray XC30:
  - 2x Xeon E5-2697 v2 (24C)
  - Cray Aries interconnect
  - Cray MPI
  - Dragonfly
- NEC HPC1812Rg-2 node:
  - 2x Xeon E5-2650 v4 (24C)
  - Intel Omni-Path interconnect
  - Intel MPI
  - Fat tree
- HPE SGI 8600 node:
  - 2x Xeon Gold 6148 (40C)
  - Dual-rail InfiniBand 4X EDR
  - HPE SGI MPI
  - Enhanced hypercube

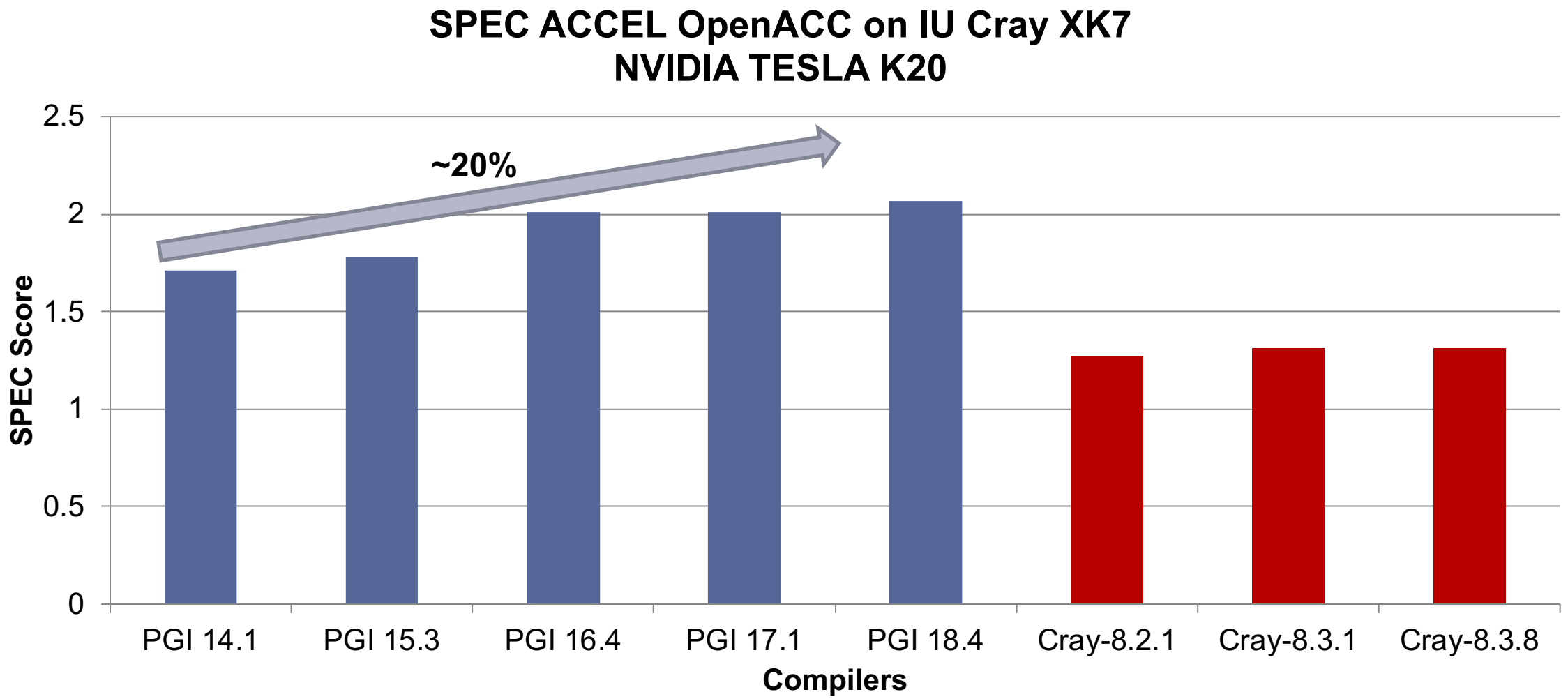
Same Programming Model on Different Hardware



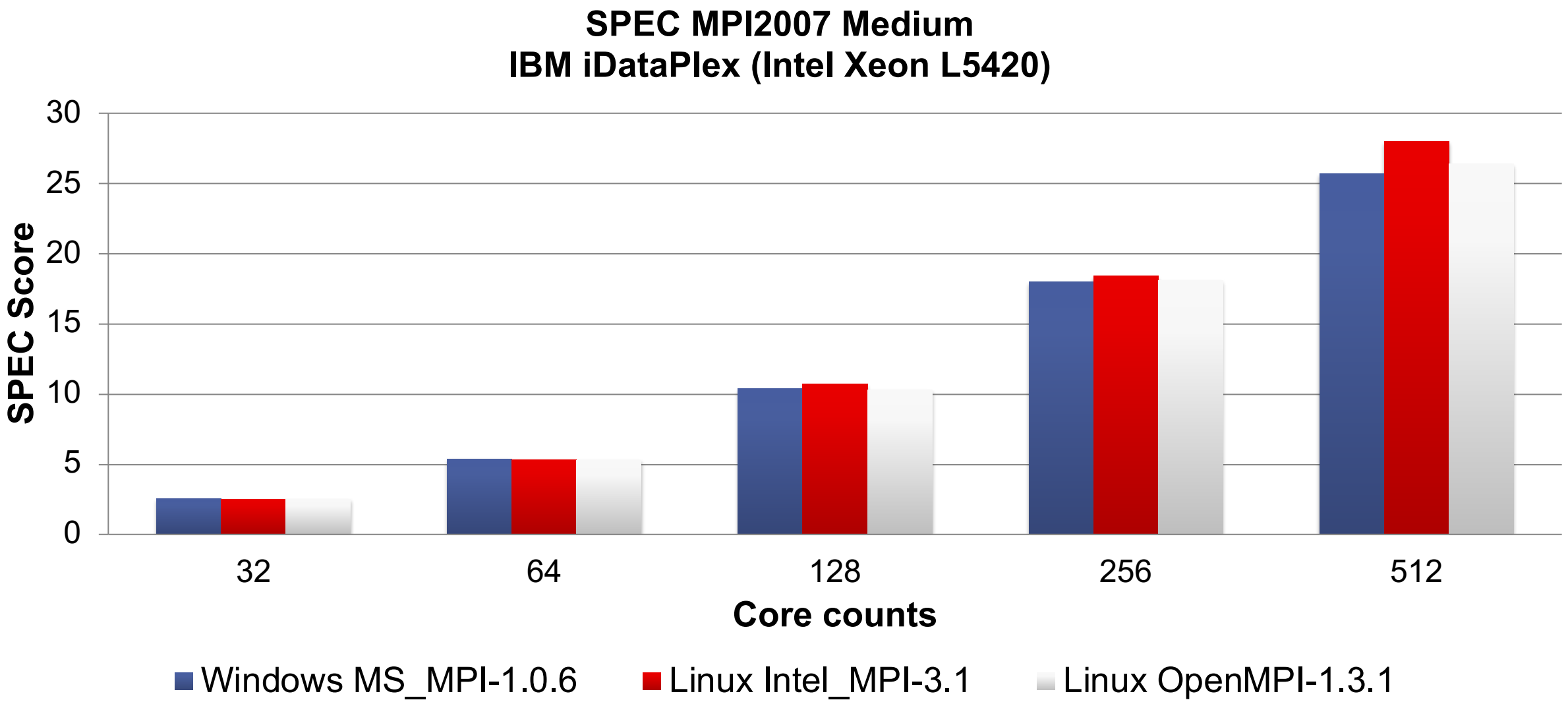
Same Programming Model on Different Hardware



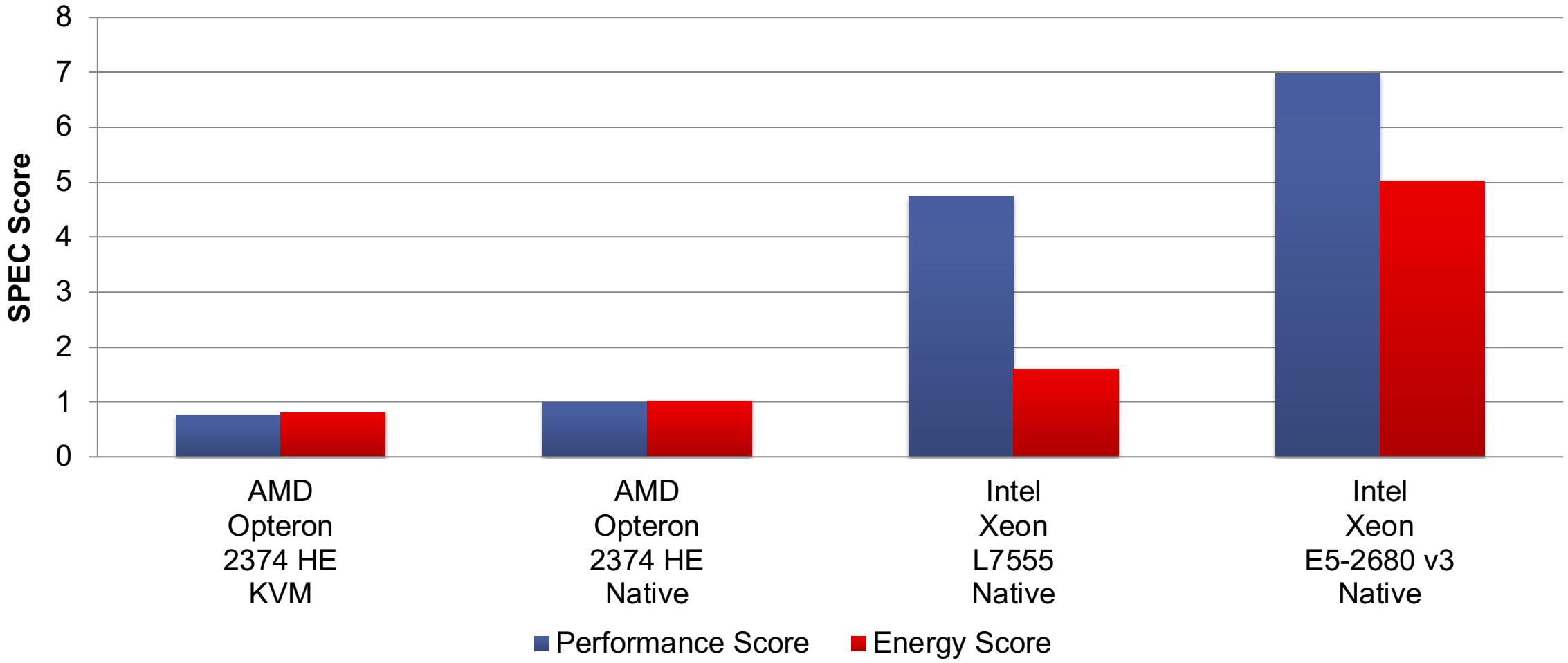
Compiler Evolution – PGI and Cray OpenACC



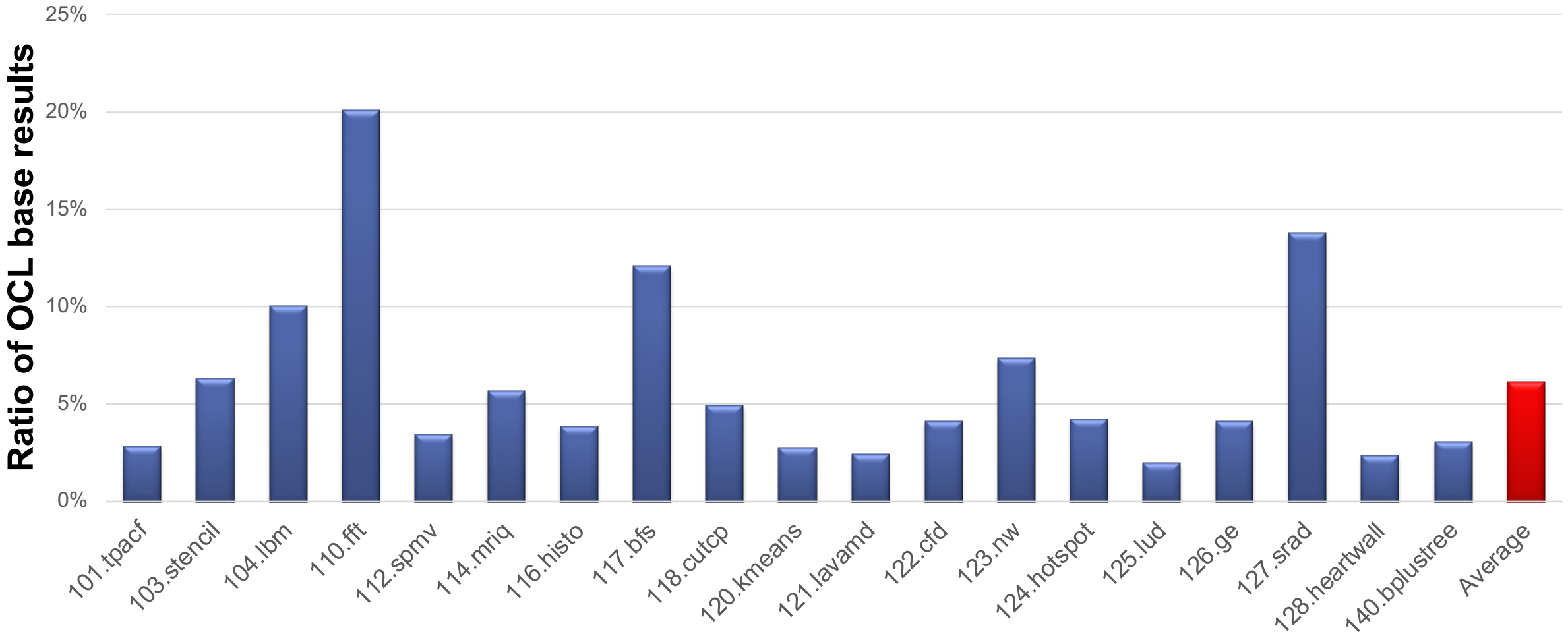
Comparing Different MPI Libraries and OSes



SPEC OMP2012
Performance and Energy



SPEC ACCEL OpenCL
The effect of ECC (Using results for NVIDIA K40c, base)



Comparing Partial Results – Academic Fair Use

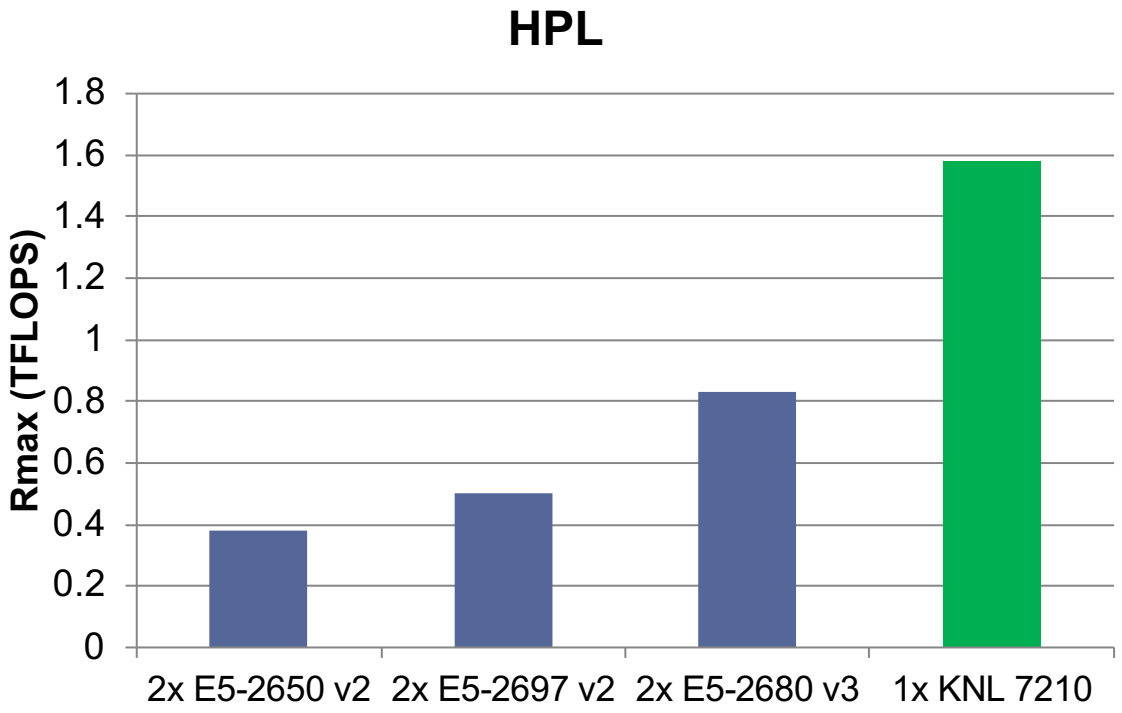
- E.g., Cray and IBM compilers support OpenMP 4.5 offload to GPUs. This shows the potential of the Cray compiler but at that time only 6 of 15 benchmarks worked!
- Non-published results are "SPEC estimate"
- Rpeak
  - KNL-7210: 2.60 Tflops
  - K20: 1.17 TFlops

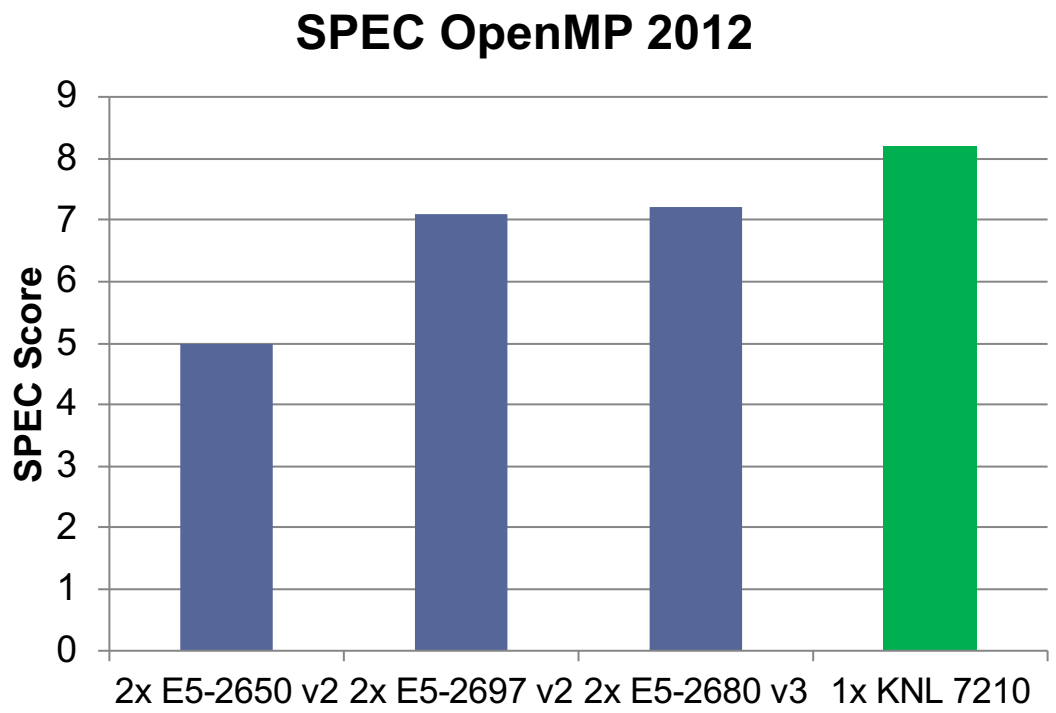
    Ratio: 2.2x

	SPEC Score (*estimate*)			Speedup	
Benchmarks	KNL(MCDRAM) Intel	KNL(DDR4) Intel	K20 Cray	**KNL(MCDRAM) vs K20**	**KNL(DDR4) vs K20**
503.postencil	1.99	0.700	1.26	1.6x	0.6x
504.polbm	3.42	0.754	0.898	3.8x	0.8x
514.pomriq	2.71	2.72	1.11	2.4x	2.4x
555.pseismic	2.83	1.06	1.43	2.0x	0.7x
560.pilbdc	8.43	1.97	4.61	1.8x	0.4x
570.pbt	27.4	20.2	18.2	1.5x	1.1x
Geometric Mean				**2.1x**	**0.8x**

And Now for Something Totally Different

- HPL vs. SPEC OpenMP 2012
- How much information is publically available about Top500 results?



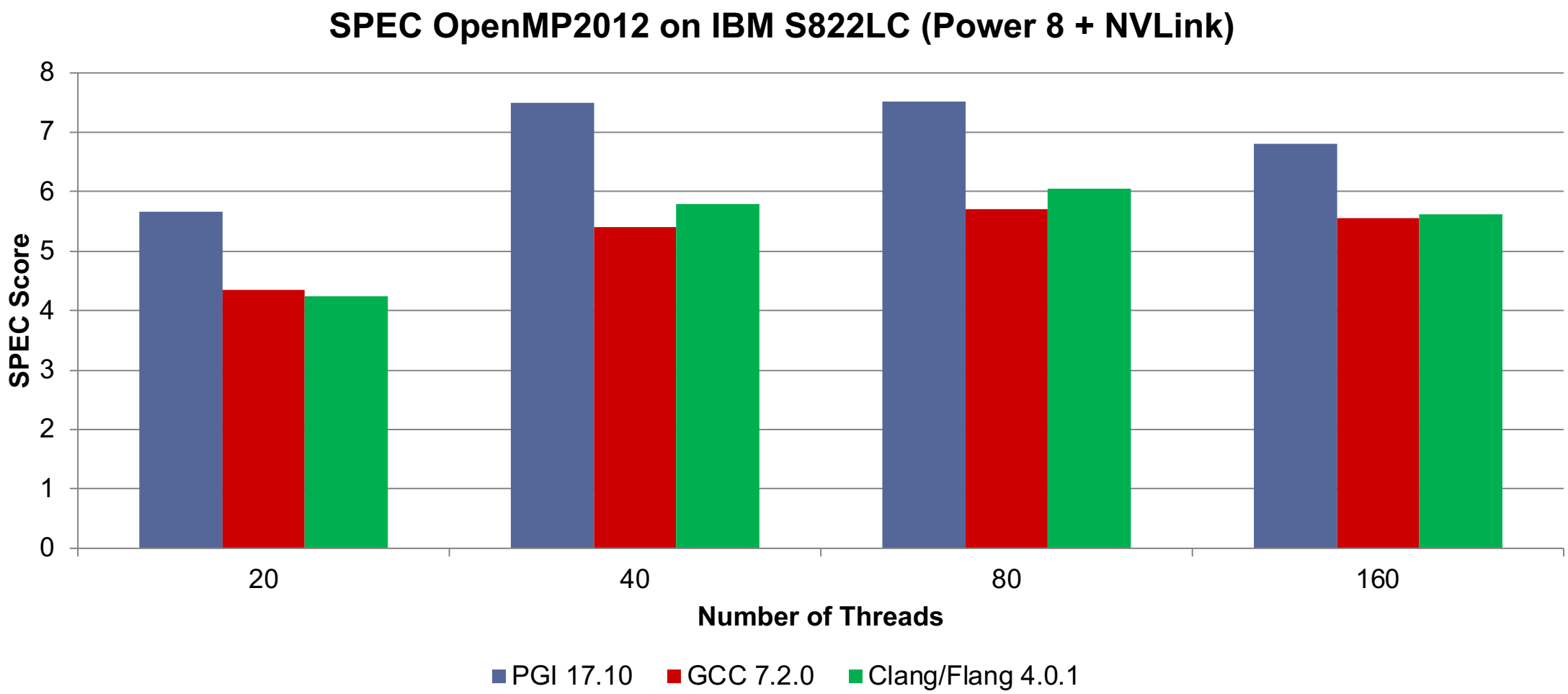


Comparing Results – Advanced Search

- Let's use the search function on the home page:
  - Advanced Search:
    - https://www.spec.org/cgi-bin/osgresults?conf=omp2012
    - Indiana University, Power8 results, showing compiler, sort by compiler first, thread count second.

- Yes, you could have done that using copy and paste, but imagine doing this with SPEC CPU2006 results!

Comparing Results – Advanced Search



Comparing Results

- Dump all Records as CSV
  - https://www.spec.org/cgi-bin/osgresults?conf=omp2012

Contents

Use Cases

- System, accelerator and software vendors
- Application developers
- Users and HPC centers
- Researchers
- HPC tool developers

Use Cases – Vendors

- Marketing
- Drive benchmark development
  - To utilize state of the art hardware/software features
- Internal validation suite
  - Compiler
  - OMP / MPI runtime libraries
- Prepare for RFPs (procurement)

Use Cases – Application Developers

- Include their application in the benchmark suite
  - See results on a lot of different systems.
- Compare hardware and software stack
  - Compilers
  - Parallel runtimes
  - Different versions of processors
  - Different interconnects

Use Cases – HPC Centers

- Include the benchmarks in the RFP (procurement) process
  - ORNL used the SPEC benchmark suites (OMP, ACCEL) during Summit acceptance
  - Test compliance of vendor and open source compilers
- Use them for performance regression testing
  - Hardware
  - Software
- System configuration and tuning
- Power consumption

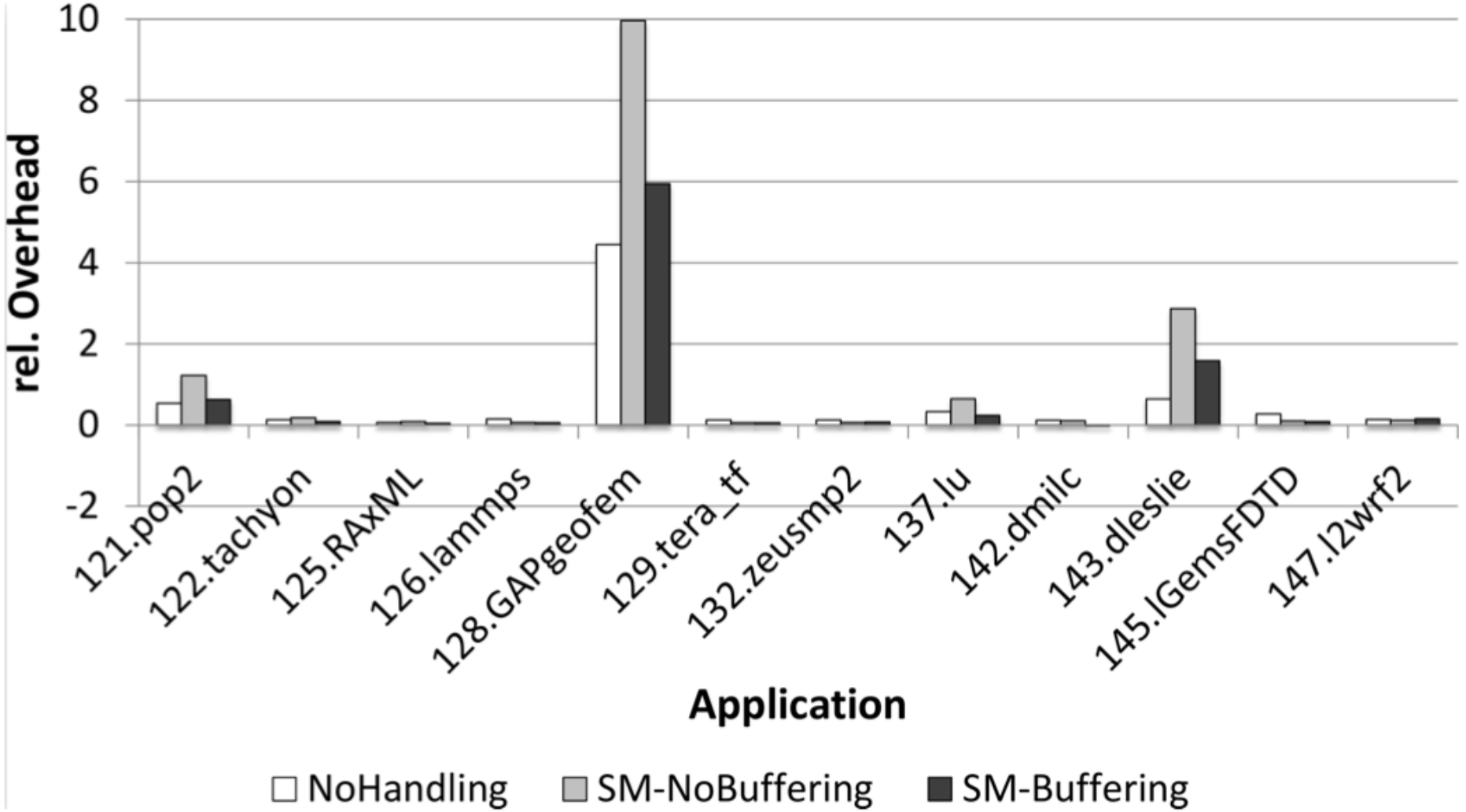
Use Cases – Researchers

- Scalability studies
- Novel implementations of parallel runtime libraries
- Detailed power consumption studies
- Comparison of parallel programming paradigms

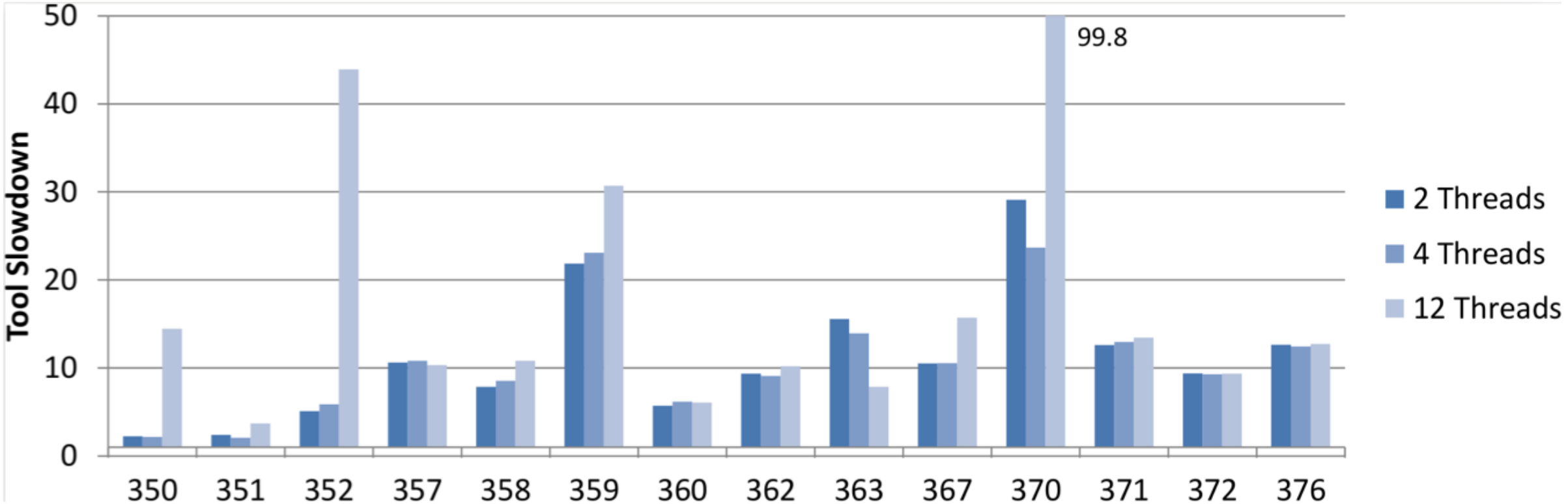
Use Cases – HPC Tool Developers

- MUST
  - Implements MPI runtime correctness analysis and reports deadlocks, mismatches in types or collective arguments and scales to more than 16k MPI ranks.
  - SPEC MPI L2007 v2 (ref) up to 2k ranks used to
    - Evaluation of general tool runtime overhead, i.e., (runtime with tool) / (runtime without tool)
    - Evaluation of the influence of specific changes in the analysis or tool infrastructure (e.g. guarantee to provide complete results when the application crashes).
      - Publications: http://www.itc.rwth-aachen.de/go/id/fddi/lidx/1/file/540356
- Archer / ThreadSanitizer
  - Data race analysis for OpenMP programs
  - SPEC OMP (train) up to 12 threads used to evaluate tool runtime overhead for data race detection.
    - Publication: http://www.itc.rwth-aachen.de/go/id/fddi/lidx/1/file/706852
- OMPT Interface of Intel/LLVM OMP runtime
  - OMPT (OpenMP tools interface) implementation in the LLVM/Intel OpenMP runtime
  - Requirement by Intel: negligible overhead in the absence of a OMPT tool
  - SPEC OMP 2012 (ref) was used for evaluation of the overhead of the OMPT implementation and acceptance test of the OMPT implementation.

Use Cases – MUST (MPI Correctness and Deadlocks)



Use Cases – Archer / ThreadSanitizer (Data Race Det)



Thank you!

Questions?

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