Survey to elicit comments on the HEPScore benchmark

It is time to get the feedback of the Task Force.

We have an extensive set of measurements of the commercial benchmarks (HEPSpec06 and SPEC2017) and measurements of 11 experimental workloads

HEPScore candidates will be created from the 11 workloads but we would like to keep the number of candidates to a manageable size

A survey will be circulated (very soon) that will help us determine our direction

The survey will be anonymous and the results presented in the July TF meeting

The goal would be to present the analysis of the HEPScore candidates in the September Workshop

The aim is to finalize a HEPScore benchmark by the end of 2022.

Current status of workloads

We have a good set of HEPSpec06 (32 and 64 bit) and SPEC0217 (intrate and cpp) measurements

We have 11 different experiment workloads
LHCb, BelleII, ATLAS (gen, sim,reco), CMS (gen, digi, sim), JUNO, ALICE, GW

Three workloads still need more measurements in order to include them into a HEPScore candidate
Gravity wave (LIGO), ALICE (gen_sim) and ATLAS (reco) have measurements on <20 CPU-systems

Other workloads have measurements on 50-60 CPU-systems
[CPU-System = CPU, #cores, hyperthreading setting and site]

A HEPScore candidate
requires a measurement of each workload

For example,

CMS digi
57 unique CPU-systems (CPU, cores, HT, site)
2919 measurements

ALICE (gen_sim)
13 unique CPU-systems
227 measurements

ATLAS (reco)
9 unique CPU-systems
426 measurements

cms_digi

2022-06-09 15:13:00
hepscore_wl_scores_cms_digi_run3_bmk_digi
Note: all values of benchmarks/core use the PHYSICAL number of cores

CPU	Architecture	Site	Physical Cores	HT	N	Benchmark mean	Benchmark std	Bmk/PCore mean	Bmk/PCore std	Norm Bmk mean	Norm Bmk std	RAM GB/core	
AMD_EPYC_7302_16-Core_Processor	Rome	CERN	32	1	13	7.75	0.02	0.2423	0.0005	1.41	0.00	8.2	
AMD_EPYC_7543_32-Core_Processor	Milan	CaltechLIGO	32	1	7	9.41	0.02	0.2940	0.0007	1.71	0.00	8.2	
AMD_EPYC_7551P_32-Core_Processor	Naples	Nikhef	32	1	20	5.57	0.01	0.1742	0.0003	1.02	0.00	8.2	
AMD_EPYC_7573X_32-Core_Processor	Milan	CaltechLIGO	64	1	15	19.20	0.06	0.3000	0.0010	1.75	0.01	8.2	
AMD_EPYC_75F3_32-Core_Processor	Milan	CaltechLIGO	32	1	11	9.83	0.01	0.3073	0.0005	1.79	0.00	8.2	
AMD_EPYC_7742_64-Core_Processor	Rome	GridKa	128	1	48	26.65	0.18	0.2082	0.0014	1.21	0.01	4.6	
AMD_EPYC_7742_64-Core_Processor	Rome	GridKa	256	1	240	29.82	0.31	0.1165	0.0012	0.68	0.01	2.3	2.3
AMD_EPYC_7763_64-Core_Processor	Milan	CaltechLIGO	128	1	7	28.90	0.04	0.2258	0.0003	1.32	0.00	4.1	
Intel(R)_Xeon(R)_CPU_E5-2650_v4_@_2.20GHz	Broadwell	CERN	24	1	13	4.12	0.00	0.1715	0.0002	1.00	0.00	11.0	
Intel(R)_Xeon(R)_CPU_E5-2665_0_@_2.40GHz	SandyBridgeEP	GridKa	32	1	24	2.48	0.01	0.0775	0.0002	0.45	0.00	1.5	
Intel(R)_Xeon(R)_CPU_E5-2670_0_@_2.60GHz	SandyBridgeEP	GridKa	32	1	24	3.07	0.03	0.0959	0.0010	0.56	0.01	2.1	
Intel(R)_Xeon(R)_CPU_E5-2680_v3_@_2.50GHz	Haswell	Nikhef	24	1	20	4.46	0.01	0.1858	0.0002	1.08	0.00	8.2	
Intel(R)_Xeon(R)_Gold_5218_CPU_@_2.30GHz	CascadeLake	CERN	32	1	13	6.14	0.01	0.1919	0.0002	1.12	0.00	6.1	
Intel(R)_Xeon(R)_Gold_6148_CPU_@_2.40GHz	Skylake	Nikhef	40	1	20	7.71	0.01	0.1927	0.0003	1.12	0.00	9.9	
Intel(R)_Xeon(R)_Gold_6238R_CPU_@_2.20GHz	CascadeLake	IHEP	56	1	12	9.98	0.02	0.1782	0.0004	1.04	0.00	4.7	
Intel(R)_Xeon(R)_Gold_6248_CPU_@_2.50GHz	CascadeLake	IHEP	40	1	13	7.96	0.01	0.1989	0.0002	1.16	0.00	4.9	
Intel(R)_Xeon(R)_Gold_6258R_CPU_@_2.70GHz	CascadeLake	IHEP	56	1	13	10.86	0.01	0.1939	0.0002	1.13	0.00	4.7	
Intel(R)_Xeon(R)_Gold_6338_CPU_@_2.00GHz	IceLake	IHEP	64	1	13	12.25	0.01	0.1914	0.0002	1.12	0.00	4.1	
Intel(R)_Xeon(R)_Silver_4216_CPU_@_2.10GHz	CascadeLake	CERN	32	1	31	5.93	0.04	0.1852	0.0014	1.08	0.01	6.1	6.1
AMD_EPYC_7302_16-Core_Processor	Rome	CC-IN2P3	32	2	10	10.33	0.01	0.3229	0.0005	1.88	0.00	3.1	
AMD_EPYC_7302_16-Core_Processor	Rome	CERN	32	2	18	8.77	0.02	0.2739	0.0007	1.60	0.00	4.1	
AMD_EPYC_7313_16-Core_Processor	Milan	CC-IN2P3	32	2	10	11.61	0.04	0.3629	0.0013	2.12	0.01	4.1	
AMD_EPYC_7313_16-Core_Processor	Milan	CaltechLIGO	32	2	10	13.29	0.02	0.4153	0.0008	2.42	0.00	4.1	
AMD_EPYC_7351_16-Core_Processor	Naples	INFN-T1	32	2	10	8.42	0.02	0.2631	0.0006	1.53	0.00	4.1	
AMD_EPYC_7443_24-Core_Processor	Milan	CC-IN2P3	48	2	10	15.79	0.02	0.3289	0.0005	1.92	0.00	5.5	
AMD_EPYC_7453_28-Core_Processor	Milan	CC-IN2P3	56	2	10	17.38	0.05	0.3104	0.0008	1.81	0.00	4.7	
AMD_EPYC_74F3_24-Core_Processor	Milan	CaltechLIGO	24	2	10	9.31	0.02	0.3878	0.0009	2.26	0.01	2.7	
AMD_EPYC_7513_32-Core_Processor	Milan	CC-IN2P3	64	2	10	18.38	0.03	0.2872	0.0004	1.67	0.00	4.1	
AMD_EPYC_7551P_32-Core_Processor	Naples	Nikhef	32	2	20	7.18	0.01	0.2244	0.0003	1.31	0.00	4.1	
AMD_EPYC_7702_64-Core_Processor	Rome	IJCLAB	128	2	14	28.11	0.05	0.2196	0.0004	1.28	0.00	2.1	2.1
AMD_EPYC_7702_64-Core_Processor	Rome	GridKa	128	2	24	26.97	0.27	0.2107	0.0021	1.23	0.01	2.3	2.3
AMD_EPYC_7742_64-Core_Processor	Rome	GridKa	128	2	240	30.50	0.28	0.2383	0.0022	1.39	0.01	2.3	
Intel(R)_Xeon(R)_CPU_E5-2630_v3_@_2.40GHz	Haswell	CERN	16	2	458	3.31	0.02	0.2069	0.0015	1.21	0.01	4.1	
Intel(R)_Xeon(R)_CPU_E5-2630_v3_@_2.40GHz	Haswell	GridKa	16	2	12	3.45	0.03	0.2156	0.0019	1.26	0.01	3.1	
Intel(R)_Xeon(R)_CPU_E5-2630_v4_@_2.20GHz	Broadwell	CCIPL-SUBATECH	20	2	3	4.09	0.01	0.2045	0.0004	1.19	0.00	3.3	
Intel(R)_Xeon(R)_CPU_E5-2630_v4_@_2.20GHz	Broadwell	GridKa	20	2	12	4.09	0.04	0.2043	0.0020	1.19	0.01	2.5	
Intel(R)_Xeon(R)_CPU_E5-2640_v3_@_2.60GHz	Haswell	PIC	16	2	16	3.63	0.01	0.2270	0.0004	1.32	0.00	2.1	
Intel(R)_Xeon(R)_CPU_E5-2650_v4_@_2.20GHz	Broadwell	CC-IN2P3	24	2	10	5.06	0.01	0.2109	0.0005	1.23	0.00	3.1	
Intel(R)_Xeon(R)_CPU_E5-2650_v4_@_2.20GHz	Broadwell	CERN	24	2	18	4.86	0.01	0.2023	0.0003	1.18	0.00	5.5	
Intel(R)_Xeon(R)_CPU_E5-2650_v4_@_2.20GHz	Broadwell	Nikhef	24	2	20	5.01	0.01	0.2086	0.0003	1.22	0.00	4.1	
Intel(R)_Xeon(R)_CPU_E5-2665_0_@_2.40GHz	SandyBridgeEP	GridKa	16	2	24	3.14	0.02	0.1962	0.0014	1.14	0.01	2.1	
Intel(R)_Xeon(R)_CPU_E5-2680_v2_@_2.80GHz	IvyBridgeEP	CC-IN2P3	20	2	10	4.42	0.01	0.2208	0.0003	1.29	0.00	3.3	
Intel(R)_Xeon(R)_CPU_E5-2680_v4_@_2.40GHz	Broadwell	CERN	28	2	492	6.28	0.02	0.2244	0.0006	1.31	0.00	4.7	
Intel(R)_Xeon(R)_CPU_E5-2680_v4_@_2.40GHz	Broadwell	PIC	28	2	16	6.63	0.06	0.2367	0.0022	1.38	0.01	2.4	
Intel(R)_Xeon(R)_CPU__________E5520__@_2.27GHz	NehalemEP	CA-UVic-Cloud	8	2	67	1.22	0.01	0.1525	0.0009	0.89	0.01	3.1	3.1
Intel(R)_Xeon(R)_CPU__________E5630__@_2.53GHz	WestmereEP	GridKa	8	2	12	1.39	0.00	0.1741	0.0006	1.01	0.00	1.5	
Intel(R)_Xeon(R)_Gold_5218_CPU_@_2.30GHz	CascadeLake	CERN	32	2	196	7.00	0.15	0.2186	0.0047	1.27	0.03	3.1	3.1
Intel(R)_Xeon(R)_Gold_5320_CPU_@_2.20GHz	IceLake	CC-IN2P3	52	2	10	13.09	0.03	0.2517	0.0006	1.47	0.00	5.1	
Intel(R)_Xeon(R)_Gold_6130_CPU_@_2.10GHz	Skylake	CERN	32	2	495	6.42	0.04	0.2007	0.0011	1.17	0.01	3.1	
Intel(R)_Xeon(R)_Gold_6252_CPU_@_2.10GHz	CascadeLake	BNL	48	2	10	9.72	0.37	0.2025	0.0077	1.18	0.04	2.0	
Intel(R)_Xeon(R)_Gold_6326_CPU_@_2.90GHz	IceLake	CaltechLIGO	32	2	9	10.03	0.02	0.3134	0.0008	1.83	0.00	4.1	
Intel(R)_Xeon(R)_Gold_6326_CPU_@_2.90GHz	IceLake	CC-IN2P3	32	2	10	9.40	0.04	0.2937	0.0013	1.71	0.01	4.1	
Intel(R)_Xeon(R)_Silver_4114_CPU_@_2.20GHz	Skylake	CC-IN2P3	20	2	10	4.23	0.01	0.2113	0.0003	1.23	0.00	3.3	
Intel(R)_Xeon(R)_Silver_4210_CPU_@_2.20GHz	CascadeLake	IN2P3-SUBATECH	20	2	3	4.62	0.06	0.2310	0.0028	1.35	0.02	3.3	
Intel(R)_Xeon(R)_Silver_4216_CPU_@_2.10GHz	CascadeLake	IJCLAB	32	2	33	6.88	0.06	0.2151	0.0020	1.25	0.01	2.1	
Intel(R)_Xeon(R)_Silver_4314_CPU_@_2.40GHz	IceLake	CC-IN2P3	32	2	10	8.51	0.02	0.2659	0.0006	1.55	0.00	4.1	
Intel(R)_Xeon(R)_Silver_4316_CPU_@_2.30GHz	IceLake	CC-IN2P3	40	2	10	10.06	0.12	0.2515	0.0029	1.47	0.02	3.3	

Sanity checks:
N histograms = 57
N results = 2919

Section 1 General

Should the WLCG keep HEPSpec06 or use SPEC2017 or HEPScore?

HEPSpec06 is the current WLCG benchmark

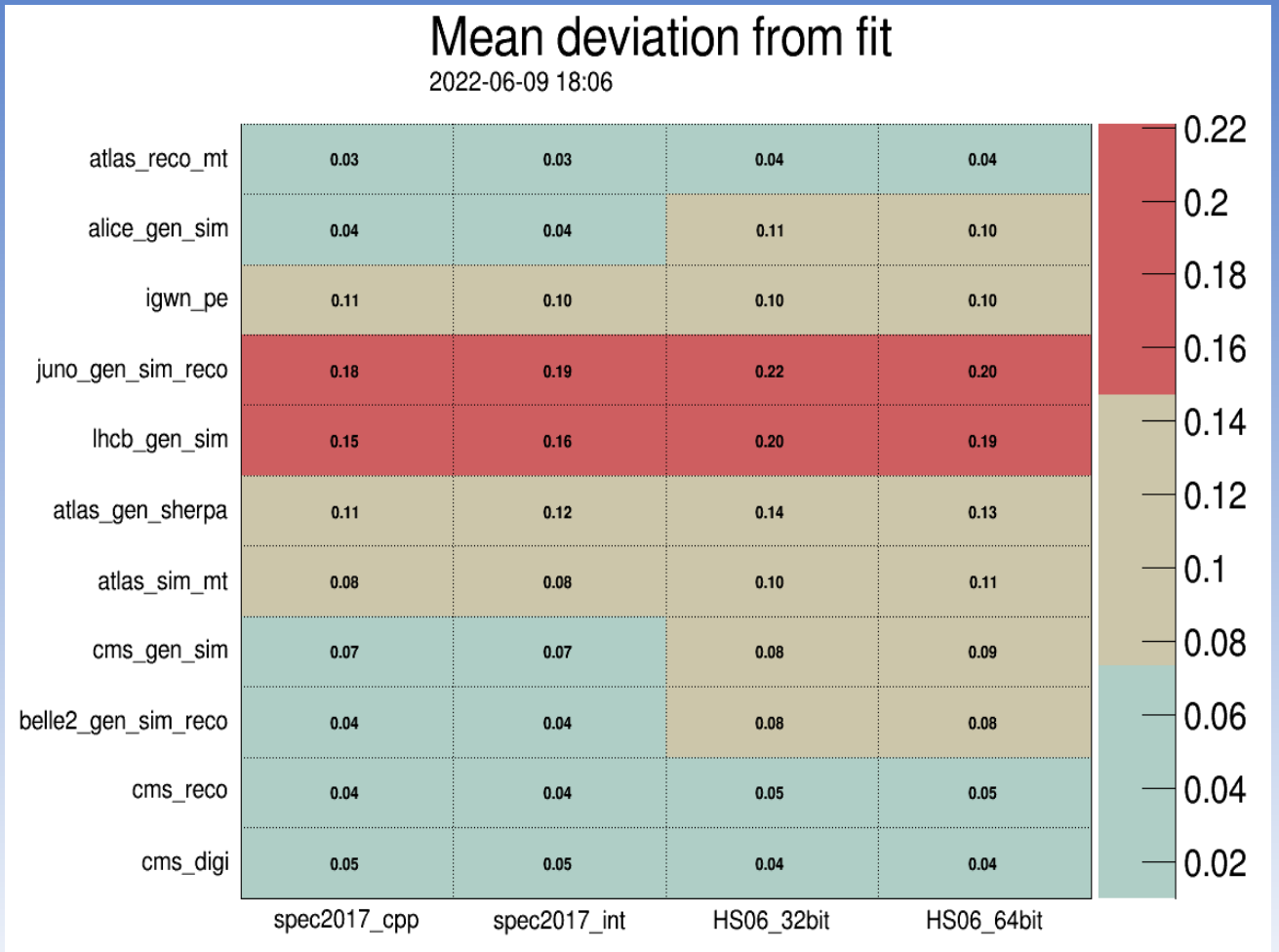
SPEC2017 would require a licence (global/site)
[Consider a “look-up” table as alternative to obtaining a licence]

HEPScore – find a benchmark that better matches our applications
[also HEPScore offers the opportunity to benchmark CPU+GPU systems]

Section 2 assumes we continue to explore HEPScore as the new WLCG benchmark

Recall some workloads agree better with HEPSpec06 and SPEC2017

atlas-reco, alice-gen-sim and igwn-pe are separated as they have fewer measurements



Section 2 HEPScore

How HEPscore should be composed:

[equally weight, experiment utilization, simulation vs gen/rec, ..]

WLCG CPU usage:

ATLAS	40%
CMS	30%
ALICE	15%
LHCb	15%

Some data from other experiments but not all sites report to WLCG
Other experiments < 5%

ATLAS and CMS provide numbers for individual components

ATLAS (sim)	0.022 events/s
ATLAS (gen)	100 events/s
ATLAS (reco)	1 event/s
CMS (gen_sim)	1 event/s
CMS (digi)	4 events/s
CMS (reco)	2 events/s

Events per second from the CERN testbed server
Intel(R)_Xeon(R)_CPU_E5-2650_v4_@_2.20GHz

Section 2 HEPScore (continued)

What is the optimal duration to run HEPScore?
[1 hour, 6 hours, 1 day]
[HS06 takes 3 hours]

Workload	Single run (min)	%
Alice	115	24
Atlas sim_mt	98	20
igwn	78	16
juno	35	7
Atlas reco	35	7
lhcb	32	6
Cms_reco	24	5
cms_gen_sim	23	5
Atlas sherpa	18	4
belle2	13	3
Cms_digi	13	3
Total	484 (8hrs)	100

Intel(R) Xeon(R) CPU E5520 @ 2.27GHz (at UVic)
Older CPU with Events/second around 50% of newer ones

Section 2 HEPScore (continued)

How long should the selected version of HEPScore be valid?
[1, 5, 10 years, LHC-Run3 period, ..]

Should HEPScore be based on the latest CPU architectures?
[80% of the utilisation is on Rome, Broadwell, Haswell, Cascade Lake, Skylake processors]
[presented in a previous TF meeting]

How should HEPScore be supported and maintained?
[currently it is a voluntary effort by members of the HEPix WG and WLCG Task Force]

Is there interest in a "fast" version of HEPScore that can be run in <30 minutes?
[the fast-benchmark could be 1 or 2 workloads that give a close approximation to the nominal-HEPScore]

Summary

The Working Group would like the input of the Task Force so that we can focus on a smaller set of HEPScore candidates

The goal is to present the results of the survey at the July 6 TF meeting
[Summer - no July 20 or Aug 3 TF meetings]

Collect missing data and present initial findings in Aug 17 TF meeting

Present results and discuss options at the September 19-20 Workshop at CERN