



Тесты демонстрации производительности для микропроцессора Baikal-T1

Список изменений

Revision	Date	Author	Description
1.0	15.03.2017		Initial version
1.1	08.08.2017		Added SPEC CPU2006 Int, iperf results

Список изменений.....	1
1. Список тестов демонстрации производительности.....	2
2. Оборудование для демонстрации производительности	4
3. Результаты тестов демонстрации производительности	5
4. Лог запуска тестов.....	7
Coremark.....	7
Whetstone.....	8
Dhrystone.....	9
STREAM	10
5. Результаты SPEC CPU2006 INT.....	11
6. Результаты Iperf.....	12

1. Список тестов демонстрации производительности

Test name	Description	Comments. What is measured? Results.
Coremark	list processing (find and sort), Matrix (mathematics) manipulation (common matrix operations), <u>state machine</u> (determine if an input stream contains valid numbers), and CRC	OpenSource Multi-threading Integer Performance Results http://www.coremark.org/benchmark
Dhrystone	Developed in 1984 by R.P. Wecker, Dhrystone is a benchmark program written in C that tests a system's integer performance. The program is CPU bound, performing no I/O functions or operating system calls. Dhrystones per second is the metric used to measure the number of times the program can run in a second. Original versions of the benchmark gave performance ratings in terms of Dhrystones per second. This was later changed to VAX MIPS by dividing Dhrystones per second by 1757, the DEC VAX 11/780 result.	Integer Performance OpenSource Results http://www.roylongbottom.org.uk/dhrystone%20results.htm
Whetstone	Measured flops performance. The Whetstone benchmark measured computing power in units of Millions of Whetstone Instructions Per Second (MWIPS). Test Loop In Tables 1. floating point MFLOP 1 2. floating point MFLOP 2 3. if then else IF MOPS 4. fixed point FIXPT MOPS 5. sin,cos etc. COS MOPS 6. floating point MFLOP 3 7. assignments EQUAL MOPS 8. exp,sqrt etc. EXP MOPS	OpenSource Multi-threading Floating-Point Performance (Double and Single precision) Results http://freespace.virgin.net/roy.longbottom/whetstone%20results.htm#anchorandroidC
Stream	This program measured memory transfer rates in MB/s for simple operations (copy, scale, add, and triad) http://www.cs.virginia.edu/stream/	Multi-threading OpenSource Results

		http://ssvb.github.io/2011/09/13/origenboard-memory-performance.html
SPEC CPU 2006 INT	<p>List of Benchmarks</p> <ul style="list-style-type: none"> 400.perlbench (C) Programming Language 401.bzip2 (C) Compression 403.gcc (C) C Compiler 429.mcf (C) Combinatorial Optimization 445.gobmk (C) Artificial Intelligence: Go 456.hmmer (C) Search Gene Sequence 458.sjeng (C) Artificial Intelligence: chess 462.libquantum (C) Physics / Quantum Computing 464.h264ref (C) Video Compression 471.omnetpp (C++) Discrete Event Simulation 473.astar (C++) Path-finding Algorithms 483.xalancbmk (C++) XML Processing 	<p>Results http://spec.org/cpu2006/results/</p>
Iperf	<p>Iperf is a test for network performance measurement. Iperf has “client” and “server” functionality, and can create data streams to measure the throughput between the two ends.</p>	OpenSource



2. Оборудование для демонстрации производительности

Процессор	CPU: MIPS32 P5600 @ 1200 MHz (Rev 1.0) FPU: Present Cores: 2 Timer: 600 MHz ECC: L1 L2 (80800ff0) PLLs: CPU: 1200MHz SATA: 600MHz ETH: 1250MHz PCIE: 1200MHz DDR3: 400MHz AXI: 600MHz
Плата	Baikal-T1 BFK2
Память	FOXLINE 4GB DDR3 1600 SODIMM CL11 1.35V S/N: FL1600D3S11SL-4G
OS	Linux 4.4.44 mipsel

3. Результаты тестов демонстрации производительности

OS: Linux 4.4.44

При сборке бенчмарков используются следующие компиляторы с опциями.
Compilers:

- *GCC 5.3 -O3 -funroll-all-loops -fgcse-sm -fgcse-las -finline-functions -finline-limit=1000 -mhard-float -EL -mtune=p5600 -falign-functions=16 -mno-dsp -static*

- Для получения максимальной производительности на coremark

в качестве компилятора использовался Mentor тулчейн 4.9.1(2014.1-22)

<https://sourcery.mentor.com/GNUToolchain/subscription3537?lite=MIPS>

с плагином (*tree_switch_shortcut_elf-2014.11-21.so*)

<http://community.imgtec.com/developers/mips/tools/benchmarks/> в качестве компоновщика

<https://sourcery.mentor.com/GNUToolchain/release2935>

GCC4.9.1 -static -O3 -funroll-all-loops -fgcse-sm -fgcse-las -finline-functions -finline-limit=1000 -msoft-float -EL -march=74kc -falign-functions=16 -mno-dsp -fplugin=./tree_switch_shortcut_elf-2014.11-21.so



Benchmark	Baikal-T1 MIPS P5600 1200 MHz		Compiler / Software
Coremark	GCC 5.3 Coremarks 12364 (2 threads) Coremarks/MHz 10.3 Coremarks/Mhz/core 5.15	Mentor GCC 4.9.1 with plugin Coremarks 13142 (2 threads) Coremarks/MHz 10.95 Coremarks/Mhz/core 5.47	GCC 5.3 MentorGCC 4.9
Dhrystone	4398 VAX MIPS (1 thread) 3.66 DMIPS/Mhz		GCC 5.3
Whetstone	1213 MWIPS (2 threads) 0.51 MWIPS/MHZ/core		GCC 5.3
STREAM	Copy: 3119.2 MB/s Scale: 3109.9 MB/s Add: 2466.9 MB/s Triad: 2467.7 MB/s		GCC 5.3
SPEC CPU2006 INT	5.0		GCC 5.3
Iperf	Bandwidth 940 Mbits/sec (TCP)		Iperf 2.0.5 GCC 5.3



4. Лог запуска тестов

Coremark

```
developer@baikal:~$ ./coremark_2
2K performance run parameters for coremark.
CoreMark Size : 666
Total ticks : 16740
Total time (secs): 16.740000
Iterations/Sec : 13142.174432
Iterations : 220000
Compiler version : GCC4.9.1
Compiler flags : -O3 -funroll-all-loops -fgcse-sm -fgcse-las -finline-functions -finline-limit=1000 -msoft-float -EL -G4
-fplugin=./tree_switch_shortcut_elf-2014.11-21.so -march=74kc -falign-functions=16 -mno-dsp -DMULTITHREAD=2
-DUSE_FORK -DPERFORMANCE_RUN=1 -lrt
Parallel Fork : 2
Memory location : Please put data memory location here
(e.g. code in flash, data on heap etc)
seedcrc : 0xe9f5
[0]crclist : 0xe714
[1]crclist : 0xe714
[0]crcmatrix : 0x1fd7
[1]crcmatrix : 0x1fd7
[0]crcstate : 0x8e3a
[1]crcstate : 0x8e3a
[0]crcfinal : 0x33ff
[1]crcfinal : 0x33ff
Correct operation validated. See readme.txt for run and reporting rules.
CoreMark 1.0 : 13142.174432 / GCC4.9.1 -O3 -funroll-all-loops -fgcse-sm -fgcse-las -finline-functions -finline-
limit=1000 -msoft-float -EL -G4 -fplugin=./tree_switch_shortcut_elf-2014.11-21.so -march=74kc -falign-functions=16
-mno-dsp -DMULTITHREAD=2 -DUSE_FORK -DPERFORMANCE_RUN=1 -lrt / Heap / 2:Fork
```



Whetstone

```
developer@baikal: $ # ./whetsmp.exe
#####
get_nprocs() - CPUs 2, Configured CPUs 2
get_phys_pages() and size - RAM Size 1.86 GB, Page Size 16384 Bytes
uname() - Linux, baikal-BFK2-1099511627775, 4.4.52-bfk2-01794-g20f0bf7-dirty
#0 SMP Thu Mar 2 19:44:53 MSK 2017, mips
```

#####

Multithreading Single Precision Whetstones 32-Bit Version 1.0
Using 2 threads

Calibrate
0.01789 Seconds 1 Passes (x 100)
0.08553 Seconds 5 Passes (x 100)
0.42394 Seconds 25 Passes (x 100)

Use 589 passes (x 100)

MFLOPS 1 343 343
MFLOPS 2 343 341
IFMOPS 14323 14308
FIXPMOPS 44852461348683
COSMOPS 10 10
MFLOPS 3 256 254
EQUMOPS 8657 8163
EXPMOPS 7 7
millisec 9685 9710
MWIPS 608 607

	MWIPS	MFLOPS 1	MFLOPS 2	MFLOPS 3	MOPS	Cos	Exp	Fixpt	If Equal
--	-------	----------	----------	----------	------	-----	-----	-------	----------

Total	1215	685	683	510	20	145833929	28632	16820	
-------	------	-----	-----	-----	----	-----------	-------	-------	--

MWIPS 1213 Based on time for last thread to finish

Results Of Calculations Thread 1

MFLOPS 1	-1.12475013732910156	MFLOPS 2	-1.13133049011230469
IFMOPS	1.0000000000000000	FIXPMOPS	12.000000000000000
COSMOPS	0.49911013245582581	MFLOPS 3	0.99999982118606567
EQUMOPS	3.0000000000000000	EXPMOPS	0.93536460399627686



Dhrystone

developer@baikal:~\$./dhry.exe

Dhrystone Benchmark, Version 2.1 (Language: C or C++)

Optimisation Opt 2 32 Bit
Register option not selected

10000 runs 0.00 seconds
100000 runs 0.01 seconds
1000000 runs 0.13 seconds
2000000 runs 0.26 seconds
4000000 runs 0.52 seconds
8000000 runs 1.04 seconds
16000000 runs 2.07 seconds

Final values (* implementation-dependent):

Int_Glob: O.K. 5 Bool_Glob: O.K. 1
Ch_1_Glob: O.K. A Ch_2_Glob: O.K. B
Arr_1_Glob[8]: O.K. 7 Arr_2_Glob8/7: O.K. 16000010
Ptr_Glob-> Ptr_Comp: * 4871392
Discr: O.K. 0 Enum_Comp: O.K. 2
Int_Comp: O.K. 17 Str_Comp: O.K. DHRYSTONE PROGRAM, SOME STRING
Next_Ptr_Glob-> Ptr_Comp: * 4871392 same as above
Discr: O.K. 0 Enum_Comp: O.K. 1
Int_Comp: O.K. 18 Str_Comp: O.K. DHRYSTONE PROGRAM, SOME STRING
Int_1_Loc: O.K. 5 Int_2_Loc: O.K. 13
Int_3_Loc: O.K. 7 Enum_Loc: O.K. 1
Str_1_Loc: O.K. DHRYSTONE PROGRAM, 1'ST STRING
Str_2_Loc: O.K. DHRYSTONE PROGRAM, 2'ND STRING

Microseconds for one run through Dhrystone: 0.13
Dhrystones per Second: 7728590
VAX MIPS rating = 4398.74



STREAM

developer@baikal:~\$./stream_mte_o2.exe

STREAM version \$Revision: 5.10 \$

This system uses 8 bytes per array element.

Array size = 50000000 (elements), Offset = 0 (elements)

Memory per array = 381.5 MiB (= 0.4 GiB).

Total memory required = 1144.4 MiB (= 1.1 GiB).

Each kernel will be executed 10 times.

The *best* time for each kernel (excluding the first iteration)
will be used to compute the reported bandwidth.

Your clock granularity/precision appears to be 1 microseconds.

Each test below will take on the order of 263863 microseconds.

(= 263863 clock ticks)

Increase the size of the arrays if this shows that
you are not getting at least 20 clock ticks per test.

WARNING -- The above is only a rough guideline.

For best results, please be sure you know the
precision of your system timer.

Function Best Rate MB/s Avg time Min time Max time
Copy: 3119.2 0.257078 0.256473 0.257991
Scale: 3109.9 0.257563 0.257247 0.257781
Add: 2466.9 0.487168 0.486440 0.487885
Triad: 2467.7 0.486916 0.486292 0.487579

Solution Validates: avg error less than 1.000000e-13 on all three arrays

5. Результаты SPEC CPU2006 INT

Результаты производительности микропроцессора БАЙКАЛ-Т1 на бенчмарке SPEC CPU2006 INT представлены на диаграмме (Рисунок. 1).

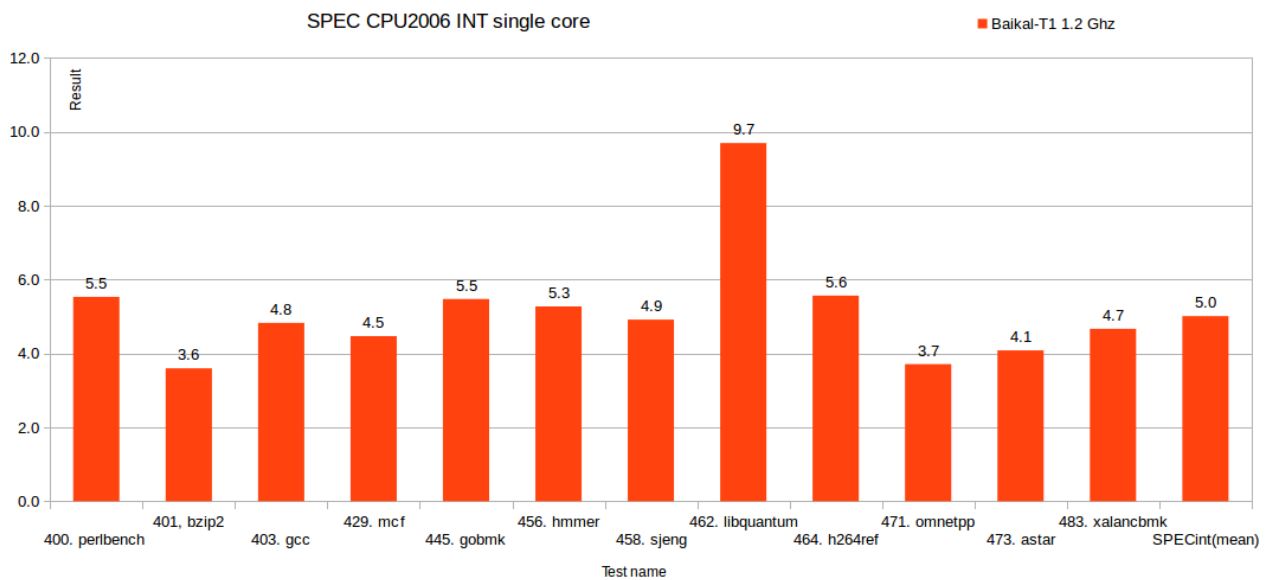


Рисунок 1. Результаты на различных бенчмарках из пакета SPEC CPU2006 INT (ref workload).

6. Результаты Iperf

Результаты на бенчмарке iperf (ver. 2.0.5, <https://iperf.fr>) предназначенного для тестирования пропускной способности интернет канала (GbE интерфейс, протокол TCP).

Байкал-Т1 в качестве «клиента»:

```
root@baikal:~# iperf -c 192.168.68.10
connect failed: Connection refused
root@baikal:~# iperf -c 192.168.68.10
```

```
-----
Client connecting to 192.168.68.10, TCP port 5001
TCP window size: 43.8 KByte (default)
```

```
-----
[ 3] local 192.168.68.27 port 51434 connected with 192.168.68.10 port 5001
[ ID] Interval   Transfer   Bandwidth
[ 3] 0.0-10.0 sec 1.10 GBytes 942 Mb/s/sec
root@baikal:~# iperf -c 192.168.68.10 -t 100
```

```
-----
Client connecting to 192.168.68.10, TCP port 5001
TCP window size: 43.8 KByte (default)
```

```
-----
[ 3] local 192.168.68.27 port 51436 connected with 192.168.68.10 port 5001
[ ID] Interval   Transfer   Bandwidth
[ 3] 0.0-100.0 sec 11.0 GBytes 941 Mb/s/sec
root@baikal:~# iperf -c 192.168.68.10 -t 300
```

```
-----
Client connecting to 192.168.68.10, TCP port 5001
TCP window size: 48.1 KByte (default)
```

```
-----
[ 3] local 192.168.68.27 port 51438 connected with 192.168.68.10 port 5001
[ ID] Interval   Transfer   Bandwidth
[ 3] 0.0-300.0 sec 32.9 GBytes 941 Mb/s/sec
```

Байкал-Т1 в качестве «сервера»:

```
root@baikal:~# iperf -s
```

```
-----
Server listening on TCP port 5001
TCP window size: 85.3 KByte (default)
```

```
-----
[ 4] local 192.168.68.27 port 5001 connected with 192.168.68.10 port 51069
[ ID] Interval   Transfer   Bandwidth
[ 4] 0.0-10.0 sec 1.10 GBytes 940 Mb/s/sec
[ 5] local 192.168.68.27 port 5001 connected with 192.168.68.10 port 51070
[ 5] 0.0-300.0 sec 32.8 GBytes 940 Mb/s/sec
```