Raspberry Pi 4 - ARM64 - BCM2711

Linux raspberry4 6.1.0-rpi8-rpi-v8 #1 SMP PREEMPT Debian 1:6.1.73-1+rpt1 (2024-01-25) aarch64 GNU/Linux - Debian

```
02.02.2024
sbc-bench v0.9.61

Installing needed tools: Done.
Checking cpufreq OPP. Done (results will be available in 8-12 minutes).
Executing tinymembench. Done.
Executing RAM latency tester. Done.
Executing OpenSSL benchmark. Done.
Executing 7-zip benchmark. Done.
Checking cpufreq OPP again. Done (10 minutes elapsed).

Results validation:

  * Measured clockspeed not lower than advertised max CPU clockspeed
  * No swapping
  * Background activity (%system) OK
  * No throttling

Memory performance
memcpy: 2469.6 MB/s
memset: 3045.1 MB/s

7-zip total scores (3 consecutive runs): 5761,5770,5774, single-threaded: 1763

OpenSSL results:
type             16 bytes     64 bytes    256 bytes   1024 bytes   8192 bytes  16384 bytes
aes-128-cbc      44875.06k    48773.55k    50142.72k    50492.76k    50591.06k    50599.25k
aes-128-cbc      44948.67k    48802.62k    50171.65k    50501.29k    50604.71k    50621.10k
aes-192-cbc      38123.15k    40896.11k    42053.03k    42355.37k    42262.53k    42259.80k
```

aes-192-cbc	38163.97k	40942.44k	42080.51k	42372.10k	42472.79k	42308.95k
aes-256-cbc	33106.75k	35206.59k	35980.80k	36156.07k	36211.37k	36225.02k
aes-256-cbc	33166.04k	35246.19k	36000.34k	36172.12k	36241.41k	36241.41k

Full Result

```
sbc-bench v0.9.61 RPi 4 Model B Rev 1.5 / BCM2711 Rev C0 or later (Fri, 02 Feb 2024
12:08:33 +0100)

Distributor ID:	Debian
Description:	Debian GNU/Linux 12 (bookworm)
Release:	12
Codename:	bookworm
Build system: bookworm main

Warning: this Raspberry Pi is powered by BCM2711 Rev. C0 or later but arm_boost=1
is not set in /boot/config.txt. Some (mis)information about what you are missing:
https://www.raspberrypi.com/news/bullseye-bonus-1-8ghz-raspberry-pi-4/

Raspberry Pi ThreadX version:
Oct 17 2023 15:39:30
Copyright (c) 2012 Broadcom
version 30f0c5e4d076da3ab4f341d88e7d505760b93ad7 (clean) (release) (start_cd)

ThreadX configuration (/boot/config.txt):
DO NOT EDIT THIS FILE
The file you are looking for has moved to /boot/firmware/config.txt

Actual ThreadX settings:
arm_64bit=1
arm_boost=1
arm_freq=1800
audio_pwm_mode=514
camera_auto_detect=-1
config_hdmi_boost=5
core_freq=500
core_freq_min=200
disable_commandline_tags=2
disable_l2cache=1
```

```
disable_overscan=1
disable_splash=1
display_auto_detect=1
display_default_lcd=1
display_hdmi_rotate=-1
display_lcd_rotate=-1
dvfs=3
enable_gic=1
enable_uart=1
force_eeprom_read=1
force_pwm_open=1
framebuffer_depth=16
framebuffer_ignore_alpha=1
framebuffer_swap=1
gpu_freq=500
gpu_freq_min=250
hdmi_blanking=2
init_uart_clock=0x2dc6c00
lcd_framerate=60
mask_gpu_interrupt0=3072
mask_gpu_interrupt1=29731
max_framebuffers=2
pause_burst_frames=1
pciex4_reset=1
program_serial_random=1
total_mem=2048
hdmi_force_cec_address:0=65535
hdmi_force_cec_address:1=65535
hdmi_pixel_freq_limit:0=0x11e1a300
hdmi_pixel_freq_limit:1=0x11e1a300

/usr/bin/gcc (Debian 12.2.0-14) 12.2.0

Uptime: 12:08:33 up 18 min,  1 user,  load average: 0.11, 0.98, 0.88,  45.8°C,  178934940

Linux 6.1.0-rpi8-rpi-v8 (raspberry4) □02/02/24 □_aarch64_□(4 CPU)

avg-cpu:  %user   %nice %system %iowait  %steal   %idle
          26.76    0.01    1.11    0.86    0.00   71.26
```

```
Device             tps    kB_read/s    kB_wrtn/s    kB_dscd/s    kB_read    kB_wrtn
kB_dscd
mmcblk0          16.91       919.11        29.47         0.00    1041588
33394          0

               total        used        free      shared  buff/cache   available
Mem:           1.9Gi       272Mi       1.5Gi       7.6Mi       185Mi       1.6Gi
Swap:           99Mi          0B        99Mi

Filename□□□□Type□□Size□□Used□□Priority
/var/swap                                file□□102396□□0□□-2

################################################################################

Checking cpufreq OPP (Cortex-A72):

Cpufreq OPP: 1800  ThreadX: 1800  Measured: 1797 @ 0.9500V
Cpufreq OPP: 1700  ThreadX: 1700  Measured: 1697 @ 0.9300V
Cpufreq OPP: 1600  ThreadX: 1600  Measured: 1597 @ 0.9100V
Cpufreq OPP: 1500  ThreadX: 1500  Measured: 1497 @ 0.8800V
Cpufreq OPP: 1400  ThreadX: 1400  Measured: 1397 @ 0.8800V
Cpufreq OPP: 1300  ThreadX: 1300  Measured: 1297 @ 0.8800V
Cpufreq OPP: 1200  ThreadX: 1200  Measured: 1197 @ 0.8800V
Cpufreq OPP: 1100  ThreadX: 1100  Measured: 1097 @ 0.8800V
Cpufreq OPP: 1000  ThreadX: 1000  Measured:  997 @ 0.8800V
Cpufreq OPP:  900  ThreadX:  900  Measured:  897 @ 0.8800V
Cpufreq OPP:  800  ThreadX:  800  Measured:  797 @ 0.8800V
Cpufreq OPP:  700  ThreadX:  700  Measured:  697 @ 0.8800V
Cpufreq OPP:  600  ThreadX:  600  Measured:  597 @ 0.8800V

################################################################################

Hardware sensors:

cpu_thermal-virtual-0
temp1:        +46.3 C  (crit = +110.0 C)

################################################################################
```

```
Executing benchmark on cpu0 (Cortex-A72):

tinymembench v0.4.9-nuumio (simple benchmark for memory throughput and latency)

CFLAGS:
bandwidth test min repeats (-b): 2
bandwidth test max repeats (-B): 3
bandwidth test mem realloc (-M): no      (-m for realloc)
      latency test repeats (-l): 3
        latency test count (-c): 1000000

==========================================================================
== Memory bandwidth tests                                               ==
==                                                                      ==
== Note 1: 1MB = 1000000 bytes                                          ==
== Note 2: Test result is the best of repeated runs. Number of repeats  ==
==         is shown in brackets                                         ==
== Note 3: Results for 'copy' tests show how many bytes can be          ==
==         copied per second (adding together read and writen           ==
==         bytes would have provided twice higher numbers)              ==
== Note 4: 2-pass copy means that we are using a small temporary buffer ==
==         to first fetch data into it, and only then write it to the   ==
==         destination (source -> L1 cache, L1 cache -> destination)    ==
== Note 5: If sample standard deviation exceeds 0.1%, it is shown in    ==
==         brackets                                                     ==
==========================================================================

 C copy backwards                                     :   2458.1 MB/s (3, 14.0%)
 C copy backwards (32 byte blocks)                    :   2500.0 MB/s (2)
 C copy backwards (64 byte blocks)                    :   2499.0 MB/s (2)
 C copy                                               :   2462.4 MB/s (2)
 C copy prefetched (32 bytes step)                    :   2457.2 MB/s (2)
 C copy prefetched (64 bytes step)                    :   2457.9 MB/s (2)
 C 2-pass copy                                        :   2052.8 MB/s (3, 2.1%)
 C 2-pass copy prefetched (32 bytes step)             :   2152.7 MB/s (2)
 C 2-pass copy prefetched (64 bytes step)             :   2139.4 MB/s (3)
 C scan 8                                             :    890.0 MB/s (2)
 C scan 16                                            :   1677.2 MB/s (3, 0.3%)
```

```
 C scan 32                                          :   3242.0 MB/s (3, 1.4%)
 C scan 64                                          :   3958.3 MB/s (3)
 C fill                                             :   3028.8 MB/s (3, 0.2%)
 C fill (shuffle within 16 byte blocks)             :   3044.4 MB/s (3, 0.2%)
 C fill (shuffle within 32 byte blocks)             :   3050.0 MB/s (3, 0.1%)
 C fill (shuffle within 64 byte blocks)             :   3049.9 MB/s (3, 1.2%)
 ---
 libc memcpy copy                                   :   2469.6 MB/s (3, 0.2%)
 libc memchr scan                                   :   3952.2 MB/s (2)
 libc memset fill                                   :   3045.1 MB/s (3, 0.4%)
 ---
 NEON LDP/STP copy                                  :   2460.4 MB/s (3, 0.1%)
 NEON LDP/STP copy pldl2strm (32 bytes step)        :   2436.7 MB/s (3, 2.2%)
 NEON LDP/STP copy pldl2strm (64 bytes step)        :   2440.7 MB/s (3, 0.1%)
 NEON LDP/STP copy pldl1keep (32 bytes step)        :   2463.3 MB/s (2)
 NEON LDP/STP copy pldl1keep (64 bytes step)        :   2461.8 MB/s (2)
 NEON LD1/ST1 copy                                  :   2457.5 MB/s (3, 1.9%)
 NEON LDP load                                      :   3978.8 MB/s (2)
 NEON LDNP load                                     :   3958.3 MB/s (2)
 NEON STP fill                                      :   3034.0 MB/s (3, 0.4%)
 NEON STNP fill                                     :   2681.3 MB/s (2)
 ARM LDP/STP copy                                   :   2456.3 MB/s (2)
 ARM LDP load                                       :   3978.0 MB/s (2)
 ARM LDNP load                                      :   4036.3 MB/s (3, 3.9%)
 ARM STP fill                                       :   3039.3 MB/s (3, 0.5%)
 ARM STNP fill                                      :   2700.4 MB/s (3, 0.6%)

==========================================================================
== Framebuffer read tests.                                              ==
==                                                                      ==
== Many ARM devices use a part of the system memory as the framebuffer, ==
== typically mapped as uncached but with write-combining enabled.       ==
== Writes to such framebuffers are quite fast, but reads are much       ==
== slower and very sensitive to the alignment and the selection of      ==
== CPU instructions which are used for accessing memory.                ==
==                                                                      ==
== Many x86 systems allocate the framebuffer in the GPU memory,         ==
== accessible for the CPU via a relatively slow PCI-E bus. Moreover,    ==
== PCI-E is asymmetric and handles reads a lot worse than writes.       ==
```

```
==                                                                      ==
== If uncached framebuffer reads are reasonably fast (at least 100 MB/s ==
== or preferably >300 MB/s), then using the shadow framebuffer layer    ==
== is not necessary in Xorg DDX drivers, resulting in a nice overall    ==
== performance improvement. For example, the xf86-video-fbturbo DDX     ==
== uses this trick.                                                     ==
==========================================================================

 NEON LDP/STP copy (from framebuffer)              :    787.8 MB/s (3, 1.4%)
 NEON LDP/STP 2-pass copy (from framebuffer)       :    702.7 MB/s (3, 0.1%)
 NEON LD1/ST1 copy (from framebuffer)              :    818.4 MB/s (3, 0.7%)
 NEON LD1/ST1 2-pass copy (from framebuffer)       :    735.7 MB/s (3, 0.3%)
 ARM LDP/STP copy (from framebuffer)               :    568.8 MB/s (3, 1.5%)
 ARM LDP/STP 2-pass copy (from framebuffer)        :    563.8 MB/s (3, 0.4%)

==========================================================================
== Memory latency test                                                  ==
==                                                                      ==
== Average time is measured for random memory accesses in the buffers   ==
== of different sizes. The larger is the buffer, the more significant   ==
== are relative contributions of TLB, L1/L2 cache misses and SDRAM      ==
== accesses. For extremely large buffer sizes we are expecting to see   ==
== page table walk with several requests to SDRAM for almost every      ==
== memory access (though 64MiB is not nearly large enough to experience ==
== this effect to its fullest).                                         ==
==                                                                      ==
== Note 1: All the numbers are representing extra time, which needs to  ==
==         be added to L1 cache latency. The cycle timings for L1 cache ==
==         latency can be usually found in the processor documentation. ==
== Note 2: Dual random read means that we are simultaneously performing ==
==         two independent memory accesses at a time. In the case if    ==
==         the memory subsystem can't handle multiple outstanding       ==
==         requests, dual random read has the same timings as two       ==
==         single reads performed one after another.                    ==
==========================================================================

block size : single random read / dual random read
      1024 :    0.0 ns          /     0.0 ns
      2048 :    0.0 ns          /     0.0 ns
```

```
      4096 :    0.0 ns          /     0.0 ns
      8192 :    0.0 ns          /     0.0 ns
     16384 :    0.0 ns          /     0.0 ns
     32768 :    0.0 ns          /     0.0 ns
     65536 :    4.8 ns          /     7.4 ns
    131072 :    7.3 ns          /     9.9 ns
    262144 :   10.5 ns          /    13.2 ns
    524288 :   12.5 ns          /    15.1 ns
   1048576 :   25.5 ns          /    39.9 ns
   2097152 :   82.5 ns          /   119.6 ns
   4194304 :  110.2 ns          /   143.1 ns
   8388608 :  130.8 ns          /   164.4 ns
  16777216 :  141.1 ns          /   175.2 ns
  33554432 :  146.6 ns          /   181.4 ns
  67108864 :  157.5 ns          /   201.3 ns

###########################################################################

Executing ramlat on cpu0 (Cortex-A72), results in ns:

       size:  1x32  2x32  1x64  2x64 1xPTR 2xPTR 4xPTR 8xPTR
         4k: 2.817 2.792 2.793 2.790 2.227 2.225 2.225 4.451
         8k: 2.784 2.782 2.782 2.791 2.226 2.226 2.231 4.451
        16k: 7.566 8.465 7.517 8.416 7.159 8.211 9.116 14.81
        32k: 10.17 10.22 10.16 10.22 9.442 10.02 15.33 30.24
        64k: 11.10 11.20 11.06 11.24 10.50 11.00 17.70 35.19
       128k: 12.25 12.29 12.26 12.29 11.68 12.65 20.62 40.23
       256k: 17.17 17.15 17.18 17.14 16.61 16.49 20.96 40.15
       512k: 17.22 17.06 17.19 17.09 21.97 16.68 20.93 40.16
      1024k: 58.70 58.33 66.02 60.31 66.12 63.73 74.69 98.63
      2048k: 134.7 143.6 141.3 140.4 138.8 117.8 133.9 168.5
      4096k: 129.6 130.0 135.5 136.3 136.1 129.7 140.7 186.5
      8192k: 151.2 153.6 153.4 154.3 153.5 153.7 154.3 191.0
     16384k: 153.3 154.6 154.2 154.6 154.1 155.4 165.3 196.9
     32768k: 155.3 155.2 154.0 155.2 154.0 158.4 163.6 199.5
     65536k: 169.9 168.5 166.6 168.1 167.2 172.6 183.0 209.2
    131072k: 172.4 169.1 167.4 169.0 168.0 172.7 184.9 231.6

###########################################################################
```

```
Executing benchmark twice on cluster 0 (Cortex-A72)

OpenSSL 3.0.11, built on 19 Sep 2023 (Library: OpenSSL 3.0.11 19 Sep 2023)
type             16 bytes     64 bytes    256 bytes   1024 bytes   8192 bytes  16384 bytes
aes-128-cbc      44875.06k    48773.55k    50142.72k    50492.76k    50591.06k
50599.25k
aes-128-cbc      44948.67k    48802.62k    50171.65k    50501.29k    50604.71k
50621.10k
aes-192-cbc      38123.15k    40896.11k    42053.03k    42355.37k    42262.53k
42259.80k
aes-192-cbc      38163.97k    40942.44k    42080.51k    42372.10k    42472.79k
42308.95k
aes-256-cbc      33106.75k    35206.59k    35980.80k    36156.07k    36211.37k
36225.02k
aes-256-cbc      33166.04k    35246.19k    36000.34k    36172.12k    36241.41k
36241.41k

########################################################################

Executing benchmark single-threaded on cpu0 (Cortex-A72)

7-Zip (a) [64] 16.02 : Copyright (c) 1999-2016 Igor Pavlov : 2016-05-21
p7zip Version 16.02 (locale=C,Utf16=off,HugeFiles=on,64 bits,4 CPUs LE)

LE
CPU Freq: - - - 64000000 128000000 - - - -

RAM size:    1898 MB,  # CPU hardware threads:   4
RAM usage:    435 MB,  # Benchmark threads:      1

                       Compressing  |                 Decompressing
Dict     Speed Usage    R/U Rating  |      Speed Usage    R/U Rating
         KiB/s     %   MIPS   MIPS  |      KiB/s     %   MIPS   MIPS

22:       1621   100   1581   1577  |      22734   100   1943   1941
23:       1582   100   1614   1612  |      22350   100   1937   1935
24:       1493   100   1608   1606  |      21951   100   1930   1927
25:       1395   100   1596   1593  |      21464   100   1913   1910
```

```
---------------------------------  | ------------------------------
Avr:             100   1600   1597  |              100   1931   1928
Tot:             100   1765   1763

################################################################################

Executing benchmark 3 times multi-threaded on CPUs 0-3

7-Zip (a) [64] 16.02 : Copyright (c) 1999-2016 Igor Pavlov : 2016-05-21
p7zip Version 16.02 (locale=C,Utf16=off,HugeFiles=on,64 bits,4 CPUs LE)

LE
CPU Freq: - - - - - - - - 2048000000

RAM size:    1898 MB,  # CPU hardware threads:   4
RAM usage:    882 MB,  # Benchmark threads:      4

                       Compressing  |                 Decompressing
Dict     Speed Usage    R/U Rating  |      Speed Usage    R/U Rating
         KiB/s     %   MIPS   MIPS  |      KiB/s     %   MIPS   MIPS

22:       4144   351   1150   4031  |      88020   398   1886   7510
23:       3892   353   1123   3966  |      86541   399   1878   7488
24:       3800   361   1132   4086  |      84796   399   1868   7444
25:       3666   365   1147   4187  |      82863   399   1850   7375
---------------------------------  | ------------------------------
Avr:             358   1138   4068  |              398   1871   7454
Tot:             378   1504   5761

7-Zip (a) [64] 16.02 : Copyright (c) 1999-2016 Igor Pavlov : 2016-05-21
p7zip Version 16.02 (locale=C,Utf16=off,HugeFiles=on,64 bits,4 CPUs LE)

LE
CPU Freq: - - - - - - - - -

RAM size:    1898 MB,  # CPU hardware threads:   4
RAM usage:    882 MB,  # Benchmark threads:      4

                       Compressing  |                 Decompressing
```

```
Dict     Speed Usage    R/U Rating  |      Speed Usage    R/U Rating
         KiB/s     %   MIPS   MIPS  |      KiB/s     %   MIPS   MIPS

22:       4130   349   1153   4018  |      87878   398   1885   7497
23:       3994   363   1120   4070  |      86147   397   1876   7454
24:       3830   364   1130   4118  |      84673   398   1866   7433
25:       3678   369   1139   4200  |      82844   399   1850   7373
----------------------------------  | ------------------------------
Avr:             361   1136   4101  |              398   1869   7439
Tot:             380   1502   5770

7-Zip (a) [64] 16.02 : Copyright (c) 1999-2016 Igor Pavlov : 2016-05-21
p7zip Version 16.02 (locale=C,Utf16=off,HugeFiles=on,64 bits,4 CPUs LE)

LE
CPU Freq: - - - - - - - - -

RAM size:    1898 MB,  # CPU hardware threads:   4
RAM usage:    882 MB,  # Benchmark threads:      4

                       Compressing  |                  Decompressing
Dict     Speed Usage    R/U Rating  |      Speed Usage    R/U Rating
         KiB/s     %   MIPS   MIPS  |      KiB/s     %   MIPS   MIPS

22:       4125   349   1150   4013  |      88221   399   1888   7527
23:       3919   357   1117   3993  |      86476   398   1878   7482
24:       3880   371   1125   4172  |      84615   398   1867   7428
25:       3681   372   1131   4203  |      82807   398   1852   7370
----------------------------------  | ------------------------------
Avr:             362   1131   4095  |              398   1871   7452
Tot:             380   1501   5774

Compression: 4068,4101,4095
Decompression: 7454,7439,7452
Total: 5761,5770,5774

################################################################################

Testing maximum cpufreq again, still under full load. System health now:
```

```
Time        fake/real   load %cpu %sys %usr %nice %io %irq   Temp    VCore
12:18:14: 1800/1800MHz  4.09  91%   2%  88%   0%   0%   0%  69.6°C  0.9500V

Checking cpufreq OPP (Cortex-A72):

Cpufreq OPP: 1800  ThreadX: 1800  Measured: 1797 @ 0.9500V

##############################################################################

Hardware sensors:

cpu_thermal-virtual-0
temp1:        +66.7 C  (crit = +110.0 C)

##############################################################################

Thermal source: /sys/devices/virtual/thermal/thermal_zone0/ (cpu-thermal)

System health while running tinymembench:

Time        fake/real   load %cpu %sys %usr %nice %io %irq   Temp    VCore
12:09:34: 1800/1800MHz  0.68  28%   1%  26%   0%   0%   0%  47.7°C  0.9500V
12:09:44: 1800/1800MHz  0.73  25%   0%  25%   0%   0%   0%  49.7°C  0.9500V
12:09:54: 1800/1800MHz  0.77  25%   0%  25%   0%   0%   0%  50.1°C  0.9500V
12:10:04: 1800/1800MHz  0.80  25%   0%  25%   0%   0%   0%  50.1°C  0.9500V
12:10:15: 1800/1800MHz  0.83  25%   0%  25%   0%   0%   0%  51.1°C  0.9500V
12:10:25: 1800/1800MHz  0.86  25%   0%  25%   0%   0%   0%  51.6°C  0.9500V
12:10:35: 1800/1800MHz  0.88  25%   0%  25%   0%   0%   0%  51.6°C  0.9500V
12:10:45: 1800/1800MHz  0.90  25%   0%  25%   0%   0%   0%  51.1°C  0.9500V
12:10:55: 1800/1800MHz  0.92  25%   0%  24%   0%   0%   0%  51.1°C  0.9500V

System health while running ramlat:

Time        fake/real   load %cpu %sys %usr %nice %io %irq   Temp    VCore
12:11:01: 1800/1800MHz  0.92  28%   1%  26%   0%   0%   0%  50.6°C  0.9500V
12:11:04: 1800/1800MHz  0.93  25%   0%  25%   0%   0%   0%  51.1°C  0.9500V
12:11:07: 1800/1800MHz  0.94  25%   0%  24%   0%   0%   0%  50.6°C  0.9500V
12:11:10: 1800/1800MHz  0.94  25%   0%  25%   0%   0%   0%  50.6°C  0.9500V
```

```
12:11:13: 1800/1800MHz  0.94  25%   0%  25%   0%   0%   0%  50.6°C  0.9500V
12:11:16: 1800/1800MHz  0.94  25%   0%  25%   0%   0%   0%  50.1°C  0.9500V
12:11:19: 1800/1800MHz  0.95  25%   0%  25%   0%   0%   0%  50.6°C  0.9500V
12:11:22: 1800/1800MHz  0.95  25%   0%  25%   0%   0%   0%  50.6°C  0.9500V
12:11:25: 1800/1800MHz  0.95  25%   0%  24%   0%   0%   0%  51.6°C  0.9500V
12:11:28: 1800/1800MHz  0.95  25%   0%  24%   0%   0%   0%  51.6°C  0.9500V
12:11:31: 1800/1800MHz  0.96  25%   1%  24%   0%   0%   0%  50.1°C  0.9500V
12:11:34: 1800/1800MHz  0.96  25%   0%  24%   0%   0%   0%  50.6°C  0.9500V

System health while running OpenSSL benchmark:

Time        fake/real   load %cpu %sys %usr %nice %io %irq   Temp    VCore
12:11:35: 1800/1800MHz  0.96  28%   1%  26%   0%   0%   0%  52.1°C  0.9500V
12:11:51: 1800/1800MHz  0.97  25%   0%  25%   0%   0%   0%  52.6°C  0.9500V
12:12:07: 1800/1800MHz  0.98  25%   0%  25%   0%   0%   0%  51.6°C  0.9500V
12:12:23: 1800/1800MHz  0.98  25%   0%  25%   0%   0%   0%  52.1°C  0.9500V
12:12:39: 1800/1800MHz  0.99  25%   0%  25%   0%   0%   0%  52.6°C  0.9500V
12:12:55: 1800/1800MHz  0.99  25%   0%  25%   0%   0%   0%  52.1°C  0.9500V
12:13:11: 1800/1800MHz  0.99  25%   0%  25%   0%   0%   0%  52.6°C  0.9500V

System health while running 7-zip single core benchmark:

Time        fake/real   load %cpu %sys %usr %nice %io %irq   Temp    VCore
12:13:23: 1800/1800MHz  1.00  28%   0%  26%   0%   0%   0%  53.1°C  0.9500V
12:13:29: 1800/1800MHz  1.00  25%   0%  24%   0%   0%   0%  52.1°C  0.9500V
12:13:35: 1800/1800MHz  1.00  25%   0%  24%   0%   0%   0%  53.6°C  0.9500V
12:13:41: 1800/1800MHz  1.00  25%   0%  24%   0%   0%   0%  52.6°C  0.9500V
12:13:47: 1800/1800MHz  1.00  25%   0%  24%   0%   0%   0%  53.6°C  0.9500V
12:13:53: 1800/1800MHz  1.00  25%   0%  25%   0%   0%   0%  52.1°C  0.9500V
12:13:59: 1800/1800MHz  1.00  25%   0%  24%   0%   0%   0%  53.1°C  0.9500V
12:14:05: 1800/1800MHz  1.00  25%   0%  24%   0%   0%   0%  53.6°C  0.9500V
12:14:11: 1800/1800MHz  1.00  25%   0%  25%   0%   0%   0%  52.6°C  0.9500V
12:14:18: 1800/1800MHz  1.00  25%   0%  24%   0%   0%   0%  53.6°C  0.9500V
12:14:24: 1800/1800MHz  1.00  25%   0%  24%   0%   0%   0%  53.1°C  0.9500V
12:14:30: 1800/1800MHz  1.00  25%   0%  24%   0%   0%   0%  53.1°C  0.9500V
12:14:36: 1800/1800MHz  1.00  25%   0%  24%   0%   0%   0%  53.1°C  0.9500V
12:14:42: 1800/1800MHz  1.00  25%   0%  24%   0%   0%   0%  52.6°C  0.9500V

System health while running 7-zip multi core benchmark:
```

```
Time        fake/real   load %cpu %sys %usr %nice %io %irq   Temp    VCore
12:14:45: 1800/1800MHz  1.00  27%   0%  26%   0%   0%   0%  53.6°C  0.9500V
12:15:01: 1800/1800MHz  1.60  90%   0%  89%   0%   0%   0%  61.8°C  0.9500V
12:15:14: 1800/1800MHz  2.13  95%   0%  94%   0%   0%   0%  63.8°C  0.9500V
12:15:32: 1800/1800MHz  2.48  92%   1%  90%   0%   0%   0%  64.8°C  0.9500V
12:15:46: 1800/1800MHz  2.96  89%   2%  87%   0%   0%   0%  64.3°C  0.9500V
12:15:59: 1800/1800MHz  3.19  96%   1%  94%   0%   0%   0%  65.2°C  0.9500V
12:16:14: 1800/1800MHz  3.37  94%   1%  93%   0%   0%   0%  68.7°C  0.9500V
12:16:27: 1800/1800MHz  3.58  96%   1%  94%   0%   0%   0%  69.6°C  0.9500V
12:16:45: 1800/1800MHz  3.72  92%   2%  90%   0%   0%   0%  70.1°C  0.9500V
12:17:01: 1800/1800MHz  4.00  90%   2%  88%   0%   0%   0%  68.2°C  0.9500V
12:17:14: 1800/1800MHz  4.14  96%   1%  94%   0%   0%   0%  69.1°C  0.9500V
12:17:27: 1800/1800MHz  4.11  95%   0%  95%   0%   0%   0%  71.1°C  0.9500V
12:17:41: 1800/1800MHz  3.94  95%   0%  94%   0%   0%   0%  72.1°C  0.9500V
12:17:58: 1800/1800MHz  3.82  93%   2%  91%   0%   0%   0%  73.0°C  0.9500V
12:18:14: 1800/1800MHz  4.09  91%   2%  88%   0%   0%   0%  69.6°C  0.9500V

###############################################################################

Linux 6.1.0-rpi8-rpi-v8 (raspberry4) □02/02/24 □_aarch64_□(4 CPU)

avg-cpu:  %user   %nice %system %iowait  %steal   %idle
          34.66    0.02    1.05    0.57    0.00   63.70

Device             tps    kB_read/s    kB_wrtn/s    kB_dscd/s    kB_read    kB_wrtn
kB_dscd
mmcblk0          11.45       608.57        20.81         0.00    1052632
35990          0

               total        used        free      shared  buff/cache   available
Mem:           1.9Gi       275Mi       1.5Gi       7.5Mi       196Mi       1.6Gi
Swap:           99Mi          0B        99Mi

Filename□□□□Type□□Size□□Used□□Priority
/var/swap                                   file□□102396□□0□□-2

CPU sysfs topology (clusters, cpufreq members, clockspeeds)
                cpufreq   min    max
```

```
 CPU    cluster  policy   speed  speed   core type
  0        0        0      600    1800   Cortex-A72 / r0p3
  1        0        0      600    1800   Cortex-A72 / r0p3
  2        0        0      600    1800   Cortex-A72 / r0p3
  3        0        0      600    1800   Cortex-A72 / r0p3

Architecture:                       aarch64
CPU op-mode(s):                     32-bit, 64-bit
Byte Order:                         Little Endian
CPU(s):                             4
On-line CPU(s) list:                0-3
Vendor ID:                          ARM
Model name:                         Cortex-A72
Model:                              3
Thread(s) per core:                 1
Core(s) per cluster:                4
Socket(s):                          -
Cluster(s):                         1
Stepping:                           r0p3
CPU(s) scaling MHz:                 100%
CPU max MHz:                        1800.0000
CPU min MHz:                        600.0000
BogoMIPS:                           108.00
Flags:                              fp asimd evtstrm crc32 cpuid
L1d cache:                          128 KiB (4 instances)
L1i cache:                          192 KiB (4 instances)
L2 cache:                           1 MiB (1 instance)
Vulnerability Gather data sampling: Not affected
Vulnerability Itlb multihit:        Not affected
Vulnerability L1tf:                 Not affected
Vulnerability Mds:                  Not affected
Vulnerability Meltdown:             Not affected
Vulnerability Mmio stale data:      Not affected
Vulnerability Retbleed:             Not affected
Vulnerability Spec rstack overflow: Not affected
Vulnerability Spec store bypass:    Vulnerable
Vulnerability Spectre v1:           Mitigation; __user pointer sanitization
Vulnerability Spectre v2:           Vulnerable
Vulnerability Srbds:                Not affected
```

```
Vulnerability Tsx async abort:      Not affected

SoC guess: BCM2711C0 or later
DT compat: raspberrypi,4-model-b
           brcm,bcm2711
 Compiler: /usr/bin/gcc (Debian 12.2.0-14) 12.2.0 / aarch64-linux-gnu
 Userland: arm64
  ThreadX: 30f0c5e4d076da3ab4f341d88e7d505760b93ad7 / Oct 17 2023 15:39:30
           alloc failures:     0
           compactions:        0
           legacy block fails: 0
   Kernel: 6.1.0-rpi8-rpi-v8/aarch64
           CONFIG_HZ=250
           CONFIG_HZ_250=y
           CONFIG_PREEMPTION=y
           CONFIG_PREEMPT=y
           CONFIG_PREEMPT_BUILD=y
           CONFIG_PREEMPT_COUNT=y
           CONFIG_PREEMPT_NOTIFIERS=y
           CONFIG_PREEMPT_RCU=y

################################################################################

   opp-table-threadx-0:
       600 MHz    880.0 mV
       700 MHz    880.0 mV
       800 MHz    880.0 mV
       900 MHz    880.0 mV
      1000 MHz    880.0 mV
      1100 MHz    880.0 mV
      1200 MHz    880.0 mV
      1300 MHz    880.0 mV
      1400 MHz    880.0 mV
      1500 MHz    880.0 mV
      1600 MHz    910.0 mV
      1700 MHz    930.0 mV
      1800 MHz    950.0 mV

################################################################################
```

```
Results validation:

  * Measured clockspeed not lower than advertised max CPU clockspeed
  * No swapping
  * Background activity (%system) OK
  * No throttling

Status of performance related policies found below /sys:

  * /sys/module/pcie_aspm/parameters/policy: default performance [powersave]
powersupersave

| RPi 4 Model B Rev 1.5 / BCM2711 Rev C0 or later | 1800 MHz | 6.1 | Debian GNU/Linux 12
(bookworm) arm64 | 5770 | 1763 | 36230 | 2470 | 3050 | - |
```

Linux raspberry4 6.1.21-v8+ #1642 SMP PREEMPT Mon Apr 3 17:24:16 BST 2023 aarch64 GNU/Linux

```
08.07.2023
sbc-bench v0.9.42

Checking cpufreq OPP. Done (results will be available in 8-12 minutes).
Executing tinymembench. Done.
Executing RAM latency tester. Done.
Executing OpenSSL benchmark. Done.
Executing 7-zip
benchmark...

             Done.
Checking cpufreq OPP again. Done (11 minutes elapsed).

Results validation:

  * Measured clockspeed not lower than advertised max CPU clockspeed
  * No swapping
  * Background activity (%system) OK
  * No throttling
```

```
Memory performance
memcpy: 2473.6 MB/s
memset: 3060.3 MB/s

7-zip total scores (3 consecutive runs): 5654,5572,5736, single-threaded: 1740

OpenSSL results:
type             16 bytes     64 bytes    256 bytes   1024 bytes   8192 bytes  16384 bytes
aes-128-cbc      45255.64k    48791.49k    50088.62k    50442.92k    50547.37k    50801.32k
aes-128-cbc      45413.82k    48878.63k    50201.60k    50520.06k    50612.91k    50828.63k
aes-192-cbc      38521.58k    41000.45k    42088.70k    42390.19k    42459.14k    42461.87k
aes-192-cbc      38519.55k    40951.77k    42070.19k    42358.78k    42472.79k    42314.41k
aes-256-cbc      33434.53k    35279.66k    36005.72k    36202.50k    36257.79k    36257.79k
aes-256-cbc      33435.35k    35303.62k    36004.27k    36198.40k    36244.14k    36235.95k
```

Full Result

```
sbc-bench v0.9.42 RPi 4 Model B Rev 1.5 / BCM2711 Rev C0 or later (Sat, 08 Jul 2023
14:41:02 +0200)

Distributor ID:	Debian
Description:	Debian GNU/Linux 11 (bullseye)
Release:	11
Codename:	bullseye
Build system:   http://archive.raspberrypi.org/debian/ bullseye main

Raspberry Pi ThreadX version:
Mar 17 2023 10:50:56
Copyright (c) 2012 Broadcom
version 82f3750a65fadae9a38077e3c2e217ad158c8d54 (clean) (release) (start_cd)

ThreadX configuration (/boot/config.txt):
disable_splash=1
hdmi_blanking=2
dtparam=i2c_arm=on
dtparam=spi=on
dtparam=audio=off
dtoverlay=disable-bt
display_auto_detect=1
```

```
dtoverlay=vc4-kms-v3d
max_framebuffers=2
arm_64bit=1
disable_overscan=1
[cm4]
otg_mode=1
[pi4]
arm_boost=1
gpu_mem=16
[all]
gpu_mem=16
start_x=1
[pi3]
gpu_mem=16
[pi0]
gpu_mem=16

Actual ThreadX settings:
arm_64bit=1
arm_boost=1
arm_freq=1800
audio_pwm_mode=514
camera_auto_detect=-1
config_hdmi_boost=5
core_freq=500
core_freq_min=200
disable_commandline_tags=2
disable_l2cache=1
disable_overscan=1
disable_splash=1
display_auto_detect=1
display_default_lcd=1
display_hdmi_rotate=-1
display_lcd_rotate=-1
dvfs=3
enable_gic=1
enable_uart=1
force_eeprom_read=1
force_pwm_open=1
```

```
framebuffer_depth=16
framebuffer_ignore_alpha=1
framebuffer_swap=1
gpu_freq=500
gpu_freq_min=250
hdmi_blanking=2
init_uart_clock=0x2dc6c00
lcd_framerate=60
mask_gpu_interrupt0=3072
mask_gpu_interrupt1=29731
max_framebuffers=2
pause_burst_frames=1
program_serial_random=1
total_mem=2048
hdmi_force_cec_address:0=65535
hdmi_force_cec_address:1=65535
hdmi_pixel_freq_limit:0=0x11e1a300
hdmi_pixel_freq_limit:1=0x11e1a300

/usr/bin/gcc (Debian 10.2.1-6) 10.2.1 20210110

Uptime: 14:41:02 up 5 min,  1 user,  load average: 0.72, 0.66, 0.33,  45.8°C,  214368480

Linux 6.1.21-v8+ (raspberrypi4) □07/08/23 □_aarch64_□(4 CPU)

avg-cpu:  %user   %nice %system %iowait  %steal   %idle
           4.38    0.05    3.48    5.72    0.00   86.37

Device             tps    kB_read/s    kB_wrtn/s    kB_dscd/s    kB_read    kB_wrtn
kB_dscd
mmcblk0          56.59      1837.18      1341.78         0.00     632081
461641          0

               total        used        free      shared  buff/cache   available
Mem:           1.9Gi        91Mi       1.6Gi       0.0Ki       140Mi       1.7Gi
Swap:           99Mi          0B        99Mi

Filename□□□□Type□□Size□Used□Priority
/var/swap                                □file    □102396□0□-2
```

```
################################################################################

Checking cpufreq OPP (Cortex-A72):

Cpufreq OPP: 1800  ThreadX: 1800  Measured: 1795 @ 0.9460V
Cpufreq OPP: 1700  ThreadX: 1700  Measured: 1695 @ 0.9240V
Cpufreq OPP: 1600  ThreadX: 1600  Measured: 1595 @ 0.9020V
Cpufreq OPP: 1500  ThreadX: 1500  Measured: 1495 @ 0.8800V
Cpufreq OPP: 1400  ThreadX: 1400  Measured: 1395 @ 0.8800V
Cpufreq OPP: 1300  ThreadX: 1300  Measured: 1295 @ 0.8800V
Cpufreq OPP: 1200  ThreadX: 1200  Measured: 1195 @ 0.8800V
Cpufreq OPP: 1100  ThreadX: 1100  Measured: 1095 @ 0.8800V
Cpufreq OPP: 1000  ThreadX: 1000  Measured:  995 @ 0.8800V
Cpufreq OPP:  900  ThreadX:  900  Measured:  895 @ 0.8800V
Cpufreq OPP:  800  ThreadX:  800  Measured:  795 @ 0.8800V
Cpufreq OPP:  700  ThreadX:  700  Measured:  695 @ 0.8800V
Cpufreq OPP:  600  ThreadX:  600  Measured:  595 @ 0.8800V

################################################################################

Hardware sensors:

cpu_thermal-virtual-0
temp1:        +47.7 C  (crit = +110.0 C)

################################################################################

Executing benchmark on cpu0 (Cortex-A72):

tinymembench v0.4.9-nuumio (simple benchmark for memory throughput and latency)

CFLAGS:
bandwidth test min repeats (-b): 2
bandwidth test max repeats (-B): 3
bandwidth test mem realloc (-M): no      (-m for realloc)
      latency test repeats (-l): 3
        latency test count (-c): 1000000
```

```
==========================================================================
== Memory bandwidth tests                                               ==
==                                                                      ==
== Note 1: 1MB = 1000000 bytes                                          ==
== Note 2: Test result is the best of repeated runs. Number of repeats  ==
==         is shown in brackets                                         ==
== Note 3: Results for 'copy' tests show how many bytes can be          ==
==         copied per second (adding together read and writen           ==
==         bytes would have provided twice higher numbers)              ==
== Note 4: 2-pass copy means that we are using a small temporary buffer ==
==         to first fetch data into it, and only then write it to the   ==
==         destination (source -> L1 cache, L1 cache -> destination)    ==
== Note 5: If sample standard deviation exceeds 0.1%, it is shown in    ==
==         brackets                                                     ==
==========================================================================

 C copy backwards                                     :   2494.8 MB/s (3, 13.9%)
 C copy backwards (32 byte blocks)                    :   2500.4 MB/s (3, 0.2%)
 C copy backwards (64 byte blocks)                    :   2497.7 MB/s (3, 0.1%)
 C copy                                               :   2466.2 MB/s (2)
 C copy prefetched (32 bytes step)                    :   2463.6 MB/s (3, 2.9%)
 C copy prefetched (64 bytes step)                    :   2462.2 MB/s (2)
 C 2-pass copy                                        :   2059.8 MB/s (3, 0.2%)
 C 2-pass copy prefetched (32 bytes step)             :   2165.2 MB/s (2)
 C 2-pass copy prefetched (64 bytes step)             :   2154.4 MB/s (2)
 C scan 8                                             :    888.2 MB/s (3, 0.1%)
 C scan 16                                            :   1676.6 MB/s (3, 0.2%)
 C scan 32                                            :   3253.6 MB/s (2)
 C scan 64                                            :   3965.1 MB/s (2)
 C fill                                               :   3058.3 MB/s (3, 0.3%)
 C fill (shuffle within 16 byte blocks)               :   3073.5 MB/s (3, 0.2%)
 C fill (shuffle within 32 byte blocks)               :   3079.9 MB/s (3, 1.0%)
 C fill (shuffle within 64 byte blocks)               :   3053.4 MB/s (3, 0.3%)
 ---
 libc memcpy copy                                     :   2473.6 MB/s (3)
 libc memchr scan                                     :   3966.3 MB/s (2)
 libc memset fill                                     :   3060.3 MB/s (3, 0.4%)
 ---
 NEON LDP/STP copy                                    :   2463.3 MB/s (2)
```

```
 NEON LDP/STP copy pldl2strm (32 bytes step)      :   2445.0 MB/s (3, 2.8%)
 NEON LDP/STP copy pldl2strm (64 bytes step)      :   2447.9 MB/s (2)
 NEON LDP/STP copy pldl1keep (32 bytes step)      :   2468.3 MB/s (2)
 NEON LDP/STP copy pldl1keep (64 bytes step)      :   2468.0 MB/s (3, 0.2%)
 NEON LD1/ST1 copy                                :   2457.0 MB/s (3, 1.7%)
 NEON LDP load                                    :   3985.1 MB/s (2)
 NEON LDNP load                                   :   3962.6 MB/s (3)
 NEON STP fill                                    :   3041.3 MB/s (2)
 NEON STNP fill                                   :   2735.8 MB/s (3, 2.9%)
 ARM LDP/STP copy                                 :   2463.4 MB/s (2)
 ARM LDP load                                     :   3984.9 MB/s (3, 3.8%)
 ARM LDNP load                                    :   3957.3 MB/s (2)
 ARM STP fill                                     :   3061.2 MB/s (3, 0.5%)
 ARM STNP fill                                    :   2668.6 MB/s (3, 1.8%)

==========================================================================
== Framebuffer read tests.                                              ==
==                                                                      ==
== Many ARM devices use a part of the system memory as the framebuffer, ==
== typically mapped as uncached but with write-combining enabled.       ==
== Writes to such framebuffers are quite fast, but reads are much       ==
== slower and very sensitive to the alignment and the selection of      ==
== CPU instructions which are used for accessing memory.                ==
==                                                                      ==
== Many x86 systems allocate the framebuffer in the GPU memory,         ==
== accessible for the CPU via a relatively slow PCI-E bus. Moreover,    ==
== PCI-E is asymmetric and handles reads a lot worse than writes.       ==
==                                                                      ==
== If uncached framebuffer reads are reasonably fast (at least 100 MB/s ==
== or preferably >300 MB/s), then using the shadow framebuffer layer    ==
== is not necessary in Xorg DDX drivers, resulting in a nice overall    ==
== performance improvement. For example, the xf86-video-fbturbo DDX     ==
== uses this trick.                                                     ==
==========================================================================

 NEON LDP/STP copy (from framebuffer)             :    813.7 MB/s (3, 0.5%)
 NEON LDP/STP 2-pass copy (from framebuffer)      :    735.8 MB/s (3, 3.8%)
 NEON LD1/ST1 copy (from framebuffer)             :    848.4 MB/s (3, 0.2%)
 NEON LD1/ST1 2-pass copy (from framebuffer)      :    766.3 MB/s (3, 0.4%)
```

```
 ARM LDP/STP copy (from framebuffer)              :    609.6 MB/s (2)
 ARM LDP/STP 2-pass copy (from framebuffer)       :    579.2 MB/s (3, 0.5%)

==========================================================================
== Memory latency test                                                  ==
==                                                                      ==
== Average time is measured for random memory accesses in the buffers   ==
== of different sizes. The larger is the buffer, the more significant   ==
== are relative contributions of TLB, L1/L2 cache misses and SDRAM      ==
== accesses. For extremely large buffer sizes we are expecting to see   ==
== page table walk with several requests to SDRAM for almost every      ==
== memory access (though 64MiB is not nearly large enough to experience ==
== this effect to its fullest).                                         ==
==                                                                      ==
== Note 1: All the numbers are representing extra time, which needs to  ==
==         be added to L1 cache latency. The cycle timings for L1 cache ==
==         latency can be usually found in the processor documentation. ==
== Note 2: Dual random read means that we are simultaneously performing ==
==         two independent memory accesses at a time. In the case if    ==
==         the memory subsystem can't handle multiple outstanding       ==
==         requests, dual random read has the same timings as two       ==
==         single reads performed one after another.                    ==
==========================================================================

block size : single random read / dual random read
      1024 :    0.0 ns          /     0.0 ns
      2048 :    0.0 ns          /     0.0 ns
      4096 :    0.0 ns          /     0.0 ns
      8192 :    0.0 ns          /     0.0 ns
     16384 :    0.0 ns          /     0.0 ns
     32768 :    0.0 ns          /     0.0 ns
     65536 :    4.8 ns          /     7.5 ns
    131072 :    7.3 ns          /     9.9 ns
    262144 :   10.5 ns          /    13.2 ns
    524288 :   12.6 ns          /    15.6 ns
   1048576 :   26.5 ns          /    40.2 ns
   2097152 :   82.0 ns          /   118.8 ns
   4194304 :  110.0 ns          /   142.4 ns
   8388608 :  130.5 ns          /   162.3 ns
```

```
  16777216 :  141.2 ns          /   171.1 ns
  33554432 :  146.3 ns          /   176.3 ns
  67108864 :  157.4 ns          /   192.9 ns

########################################################################

Executing ramlat on cpu0 (Cortex-A72), results in ns:

       size:  1x32  2x32  1x64  2x64 1xPTR 2xPTR 4xPTR 8xPTR
         4k: 2.825 2.798 2.788 2.790 2.231 2.228 2.228 4.457
         8k: 2.785 2.785 2.785 2.785 2.228 2.229 2.267 4.456
        16k: 2.789 2.789 2.786 2.785 2.233 2.239 3.022 4.458
        32k: 3.977 3.996 3.996 3.994 3.422 3.504 3.803 9.605
        64k: 11.40 11.44 11.32 11.49 10.80 11.29 17.93 35.22
       128k: 12.27 12.26 12.26 12.26 11.70 12.20 20.82 40.32
       256k: 16.68 16.54 16.57 16.57 16.03 15.97 20.84 40.19
       512k: 18.27 17.54 17.99 17.51 17.57 19.61 21.12 40.55
      1024k: 74.63 55.35 68.58 66.45 74.54 58.47 66.36 92.50
      2048k: 116.2 109.2 125.8 109.5 116.2 113.2 124.8 161.2
      4096k: 129.7 129.6 133.5 132.6 133.7 135.7 138.9 186.3
      8192k: 150.5 153.0 153.0 153.6 152.9 149.3 153.9 206.9
     16384k: 152.3 153.8 153.6 153.8 153.7 155.1 159.7 197.4
     32768k: 154.3 156.7 153.5 154.5 153.3 157.9 162.1 199.4
     65536k: 167.6 172.0 168.5 167.6 167.4 170.5 180.2 206.7
    131072k: 167.8 177.8 167.6 168.3 166.5 172.6 181.3 208.1

########################################################################

Executing benchmark twice on cluster 0 (Cortex-A72)

OpenSSL 1.1.1n, built on 15 Mar 2022
type             16 bytes     64 bytes    256 bytes   1024 bytes   8192 bytes  16384 bytes
aes-128-cbc      45255.64k    48791.49k    50088.62k    50442.92k    50547.37k
50801.32k
aes-128-cbc      45413.82k    48878.63k    50201.60k    50520.06k    50612.91k
50828.63k
aes-192-cbc      38521.58k    41000.45k    42088.70k    42390.19k    42459.14k
42461.87k
aes-192-cbc      38519.55k    40951.77k    42070.19k    42358.78k    42472.79k
```

```
42314.41k
aes-256-cbc      33434.53k    35279.66k    36005.72k    36202.50k    36257.79k
36257.79k
aes-256-cbc      33435.35k    35303.62k    36004.27k    36198.40k    36244.14k
36235.95k

################################################################################

Executing benchmark single-threaded on cpu0 (Cortex-A72)

7-Zip (a) [64] 16.02 : Copyright (c) 1999-2016 Igor Pavlov : 2016-05-21
p7zip Version 16.02 (locale=C,Utf16=off,HugeFiles=on,64 bits,4 CPUs LE)

LE
CPU Freq: 64000000 - - - - - - - -

RAM size:    1899 MB,  # CPU hardware threads:   4
RAM usage:    435 MB,  # Benchmark threads:      1

                       Compressing  |                  Decompressing
Dict     Speed Usage    R/U Rating  |      Speed Usage    R/U Rating
         KiB/s     %   MIPS   MIPS  |      KiB/s     %   MIPS   MIPS

22:       1609   100   1570   1566  |      22619   100   1936   1931
23:       1533   100   1566   1563  |      22285   100   1933   1929
24:       1453   100   1566   1563  |      21890   100   1925   1922
25:       1352   100   1547   1544  |      21393   100   1907   1904
----------------------------------  | ------------------------------
Avr:              100   1562   1559  |              100   1925   1922
Tot:              100   1744   1740

################################################################################

Executing benchmark 3 times multi-threaded on CPUs 0-3

7-Zip (a) [64] 16.02 : Copyright (c) 1999-2016 Igor Pavlov : 2016-05-21
p7zip Version 16.02 (locale=C,Utf16=off,HugeFiles=on,64 bits,4 CPUs LE)

LE
```

```
CPU Freq: - - - - - - - - -

RAM size:    1899 MB,  # CPU hardware threads:   4
RAM usage:    882 MB,  # Benchmark threads:      4

                       Compressing  |                 Decompressing
Dict     Speed Usage    R/U Rating  |      Speed Usage    R/U Rating
         KiB/s     %   MIPS   MIPS  |      KiB/s     %   MIPS   MIPS

22:       3969   337   1147   3861  |      86137   393   1871   7349
23:       3869   359   1097   3943  |      84640   393   1864   7324
24:       3803   372   1099   4090  |      82911   393   1853   7278
25:       3632   371   1117   4147  |      81335   395   1833   7239
----------------------------------  | ------------------------------
Avr:             360   1115   4010  |              393   1855   7297
Tot:             377   1485   5654

7-Zip (a) [64] 16.02 : Copyright (c) 1999-2016 Igor Pavlov : 2016-05-21
p7zip Version 16.02 (locale=C,Utf16=off,HugeFiles=on,64 bits,4 CPUs LE)

LE
CPU Freq: - - - - - - - - -

RAM size:    1899 MB,  # CPU hardware threads:   4
RAM usage:    882 MB,  # Benchmark threads:      4

                       Compressing  |                 Decompressing
Dict     Speed Usage    R/U Rating  |      Speed Usage    R/U Rating
         KiB/s     %   MIPS   MIPS  |      KiB/s     %   MIPS   MIPS

22:       4001   334   1164   3893  |      87552   397   1881   7470
23:       3857   359   1095   3930  |      86029   398   1872   7444
24:       2765   231   1289   2973  |      84249   397   1863   7396
25:       3632   371   1117   4148  |      82292   398   1842   7324
----------------------------------  | ------------------------------
Avr:             324   1166   3736  |              397   1864   7408
Tot:             361   1515   5572

7-Zip (a) [64] 16.02 : Copyright (c) 1999-2016 Igor Pavlov : 2016-05-21
```

```
p7zip Version 16.02 (locale=C,Utf16=off,HugeFiles=on,64 bits,4 CPUs LE)

LE
CPU Freq: - 64000000 - - - - - - -

RAM size:    1899 MB,  # CPU hardware threads:   4
RAM usage:    882 MB,  # Benchmark threads:      4

                       Compressing  |                 Decompressing
Dict     Speed Usage    R/U Rating  |      Speed Usage    R/U Rating
         KiB/s     %   MIPS   MIPS  |      KiB/s     %   MIPS   MIPS

22:       4095   346   1151   3984  |      87889   398   1884   7498
23:       3884   362   1093   3958  |      86394   399   1876   7475
24:       3814   373   1098   4101  |      84530   398   1865   7421
25:       3618   372   1112   4131  |      82294   398   1842   7324
---------------------------------  | ------------------------------
Avr:             363   1113   4043  |              398   1867   7430
Tot:             381   1490   5736

Compression: 4010,3736,4043
Decompression: 7297,7408,7430
Total: 5654,5572,5736

##########################################################################

Testing maximum cpufreq again, still under full load. System health now:

Time        fake/real   load %cpu %sys %usr %nice %io %irq   Temp    VCore
14:51:00: 1800/1800MHz  4.35  97%   2%  94%   0%   0%   0%  76.0°C  0.9460V

Checking cpufreq OPP (Cortex-A72):

Cpufreq OPP: 1800  ThreadX: 1800  Measured: 1795 @ 0.9460V

##########################################################################

Hardware sensors:
```

```
cpu_thermal-virtual-0
temp1:        +70.6 C  (crit = +110.0 C)

################################################################################

Thermal source: /sys/devices/virtual/thermal/thermal_zone0/ (cpu-thermal)

System health while running tinymembench:

Time        fake/real   load %cpu %sys %usr %nice %io %irq   Temp    VCore
14:42:04: 1800/1800MHz  1.01  15%   3%   7%   0%   4%   0%  48.7°C  0.9460V
14:42:14: 1800/1800MHz  1.01  25%   0%  25%   0%   0%   0%  49.7°C  0.9460V
14:42:24: 1800/1800MHz  1.15  25%   0%  25%   0%   0%   0%  51.1°C  0.9460V
14:42:34: 1800/1800MHz  1.20  25%   0%  25%   0%   0%   0%  51.6°C  0.9460V
14:42:44: 1800/1800MHz  1.17  25%   0%  25%   0%   0%   0%  51.6°C  0.9460V
14:42:54: 1800/1800MHz  1.14  25%   0%  25%   0%   0%   0%  51.6°C  0.9460V
14:43:04: 1800/1800MHz  1.12  25%   0%  25%   0%   0%   0%  52.1°C  0.9460V
14:43:15: 1800/1800MHz  1.10  25%   0%  25%   0%   0%   0%  52.6°C  0.9460V
14:43:25: 1800/1800MHz  1.16  25%   0%  24%   0%   0%   0%  51.6°C  0.9460V

System health while running ramlat:

Time        fake/real   load %cpu %sys %usr %nice %io %irq   Temp    VCore
14:43:31: 1800/1800MHz  1.23  17%   2%  10%   0%   4%   0%  52.6°C  0.9460V
14:43:34: 1800/1800MHz  1.23  25%   0%  25%   0%   0%   0%  52.1°C  0.9460V
14:43:37: 1800/1800MHz  1.21  25%   0%  24%   0%   0%   0%  52.1°C  0.9460V
14:43:40: 1800/1800MHz  1.19  25%   0%  24%   0%   0%   0%  52.6°C  0.9460V
14:43:43: 1800/1800MHz  1.19  25%   0%  25%   0%   0%   0%  52.6°C  0.9460V
14:43:46: 1800/1800MHz  1.17  25%   0%  25%   0%   0%   0%  52.6°C  0.9460V
14:43:49: 1800/1800MHz  1.16  25%   0%  25%   0%   0%   0%  52.1°C  0.9460V
14:43:52: 1800/1800MHz  1.16  25%   0%  24%   0%   0%   0%  51.6°C  0.9460V
14:43:55: 1800/1800MHz  1.15  25%   0%  24%   0%   0%   0%  53.1°C  0.9460V
14:43:58: 1800/1800MHz  1.15  25%   1%  24%   0%   0%   0%  51.6°C  0.9460V
14:44:01: 1800/1800MHz  1.22  25%   1%  24%   0%   0%   0%  52.1°C  0.9460V

System health while running OpenSSL benchmark:

Time        fake/real   load %cpu %sys %usr %nice %io %irq   Temp    VCore
14:44:04: 1800/1800MHz  1.36  17%   2%  11%   0%   3%   0%  53.6°C  0.9460V
```

```
14:44:20: 1800/1800MHz  1.28  25%   0%  24%   0%   0%   0%  53.6°C  0.9460V
14:44:36: 1800/1800MHz  1.22  25%   0%  25%   0%   0%   0%  54.5°C  0.9460V
14:44:52: 1800/1800MHz  1.17  25%   0%  25%   0%   0%   0%  53.6°C  0.9460V
14:45:08: 1800/1800MHz  1.13  25%   0%  25%   0%   0%   0%  56.0°C  0.9460V
14:45:24: 1800/1800MHz  1.17  25%   0%  25%   0%   0%   0%  54.5°C  0.9460V
14:45:40: 1800/1800MHz  1.13  25%   0%  25%   0%   0%   0%  54.0°C  0.9460V

System health while running 7-zip single core benchmark:

Time        fake/real   load %cpu %sys %usr %nice %io %irq   Temp    VCore
14:45:52: 1800/1800MHz  1.11  19%   2%  13%   0%   3%   0%  56.5°C  0.9460V
14:45:59: 1800/1800MHz  1.09  25%   0%  24%   0%   0%   0%  55.0°C  0.9460V
14:46:06: 1800/1800MHz  1.08  25%   0%  24%   0%   0%   0%  54.5°C  0.9460V
14:46:14: 1800/1800MHz  1.08  25%   0%  24%   0%   0%   0%  55.5°C  0.9460V
14:46:21: 1800/1800MHz  1.06  25%   0%  24%   0%   0%   0%  55.5°C  0.9460V
14:46:28: 1800/1800MHz  1.06  25%   0%  24%   0%   0%   0%  56.0°C  0.9460V
14:46:35: 1800/1800MHz  1.05  25%   0%  24%   0%   0%   0%  55.5°C  0.9460V
14:46:42: 1800/1800MHz  1.05  25%   0%  24%   0%   0%   0%  56.0°C  0.9460V
14:46:49: 1800/1800MHz  1.12  25%   1%  24%   0%   0%   0%  56.5°C  0.9460V
14:46:56: 1800/1800MHz  1.10  25%   0%  24%   0%   0%   0%  56.0°C  0.9460V
14:47:03: 1800/1800MHz  1.09  25%   0%  24%   0%   0%   0%  56.0°C  0.9460V
14:47:10: 1800/1800MHz  1.08  25%   0%  24%   0%   0%   0%  57.5°C  0.9460V

System health while running 7-zip multi core benchmark:

Time        fake/real   load %cpu %sys %usr %nice %io %irq   Temp    VCore
14:47:17: 1800/1800MHz  1.07  20%   1%  15%   0%   2%   0%  58.9°C  0.9460V
14:47:32: 1800/1800MHz  1.65  92%   1%  91%   0%   0%   0%  63.8°C  0.9460V
14:47:47: 1800/1800MHz  2.17  93%   1%  91%   0%   0%   0%  65.2°C  0.9460V
14:48:02: 1800/1800MHz  2.72  97%   1%  95%   0%   0%   0%  67.2°C  0.9460V
14:48:19: 1800/1800MHz  3.01  89%   3%  86%   0%   0%   0%  68.2°C  0.9460V
14:48:34: 1800/1800MHz  3.37  93%   2%  91%   0%   0%   0%  70.1°C  0.9460V
14:48:49: 1800/1800MHz  3.70  94%   1%  92%   0%   0%   0%  69.1°C  0.9460V
14:49:04: 1800/1800MHz  3.62  78%   1%  77%   0%   0%   0%  69.1°C  0.9460V
14:49:20: 1800/1800MHz  3.70  86%   1%  85%   0%   0%   0%  73.0°C  0.9460V
14:49:36: 1800/1800MHz  3.85  89%   3%  85%   0%   0%   0%  71.6°C  0.9460V
14:49:51: 1800/1800MHz  4.04  94%   2%  92%   0%   0%   0%  72.1°C  0.9460V
14:50:06: 1800/1800MHz  4.27  95%   1%  93%   0%   0%   0%  74.0°C  0.9460V
14:50:25: 1800/1800MHz  4.20  94%   2%  92%   0%   0%   0%  75.0°C  0.9460V
```

```
14:50:40: 1800/1800MHz  4.36  91%   2%  89%   0%   0%   0%  74.5°C  0.9460V
14:51:00: 1800/1800MHz  4.35  97%   2%  94%   0%   0%   0%  76.0°C  0.9460V

################################################################################

Linux 6.1.21-v8+ (raspberrypi4) □07/08/23 □_aarch64_□(4 CPU)

avg-cpu:  %user   %nice %system %iowait  %steal   %idle
          32.95    0.05    2.01    2.14    0.00   62.85

Device             tps    kB_read/s    kB_wrtn/s    kB_dscd/s    kB_read    kB_wrtn
kB_dscd
mmcblk0          21.67       677.98       547.37         0.00     641929
518265          0

               total        used        free      shared  buff/cache   available
Mem:           1.9Gi        93Mi       1.7Gi       0.0Ki        85Mi       1.7Gi
Swap:           99Mi          0B        99Mi

Filename□□□□Type□□Size□Used□Priority
/var/swap                                □file    □102396□0□-2

CPU sysfs topology (clusters, cpufreq members, clockspeeds)
                 cpufreq   min    max
 CPU    cluster  policy   speed  speed   core type
  0        0        0      600    1800   Cortex-A72 / r0p3
  1        0        0      600    1800   Cortex-A72 / r0p3
  2        0        0      600    1800   Cortex-A72 / r0p3
  3        0        0      600    1800   Cortex-A72 / r0p3

Architecture:                    aarch64
CPU op-mode(s):                  32-bit, 64-bit
Byte Order:                      Little Endian
CPU(s):                          4
On-line CPU(s) list:             0-3
Thread(s) per core:              1
Core(s) per socket:              4
Socket(s):                       1
Vendor ID:                       ARM
```

```
Model:                           3
Model name:                      Cortex-A72
Stepping:                        r0p3
CPU max MHz:                     1800.0000
CPU min MHz:                     600.0000
BogoMIPS:                        108.00
L1d cache:                       128 KiB
L1i cache:                       192 KiB
L2 cache:                        1 MiB
Vulnerability Itlb multihit:     Not affected
Vulnerability L1tf:              Not affected
Vulnerability Mds:               Not affected
Vulnerability Meltdown:          Not affected
Vulnerability Mmio stale data:   Not affected
Vulnerability Retbleed:          Not affected
Vulnerability Spec store bypass: Vulnerable
Vulnerability Spectre v1:        Mitigation; __user pointer sanitization
Vulnerability Spectre v2:        Vulnerable
Vulnerability Srbds:             Not affected
Vulnerability Tsx async abort:   Not affected
Flags:                           fp asimd evtstrm crc32 cpuid

SoC guess: BCM2711C0 or later
DT compat: raspberrypi,4-model-b
           brcm,bcm2711
 Compiler: /usr/bin/gcc (Debian 10.2.1-6) 10.2.1 20210110 / aarch64-linux-gnu
 Userland: arm64
  ThreadX: 82f3750a65fadae9a38077e3c2e217ad158c8d54 / Mar 17 2023 10:50:56
           alloc failures:     0
           compactions:        0
           legacy block fails: 0
   Kernel: 6.1.21-v8+/aarch64
           CONFIG_HZ=250
           CONFIG_HZ_250=y
           CONFIG_PREEMPTION=y
           CONFIG_PREEMPTIRQ_TRACEPOINTS=y
           CONFIG_PREEMPT=y
           CONFIG_PREEMPT_BUILD=y
           CONFIG_PREEMPT_COUNT=y
```

```
            CONFIG_PREEMPT_NOTIFIERS=y
            CONFIG_PREEMPT_RCU=y

################################################################################

Kernel 6.1.21 is not latest 6.1.38 LTS that was released on 2023-07-05.

See https://endoflife.date/linux for details. Perhaps some kernel bugs have
been fixed in the meantime and maybe vulnerabilities as well.

################################################################################

Results validation:

  * Measured clockspeed not lower than advertised max CPU clockspeed
  * No swapping
  * Background activity (%system) OK
  * No throttling

| RPi 4 Model B Rev 1.5 / BCM2711 Rev C0 or later | 1800 MHz | 6.1 | Debian GNU/Linux 11
(bullseye) arm64 | 5650 | 1740 | 36250 | 2470 | 3060 | - |
```

Created 2023-07-08 12:36:08 UTC by XeroX
Updated 2024-02-02 11:28:24 UTC by XeroX