Intel® SoC Watch 2.3 for Linux* OS

Release Notes

18 April 2017

Version History

These are the main releases of Intel SoC Watch for Linux* OS.

Date	Revision	Description
July 2015	2.0	Initial release for 2.0 Product
October 2015	2.1	Update to 2.1 Product release
June 2016	2.2	Update to 2.2 Product release
October 2016	2.3	Update to 2.3 Product release
May 2017	2.3.1	Update to 2.3.1 Product release

Customer Support

For technical support, including answers to questions not addressed in this product, visit the technical support forum, FAQs, and other support information at: Intel System Studio forum discuss issues with your peers, ask questions of the development team, etc.

To submit an issue, go to Intel® Premier Support:
(https://employeeportal.intel.com/irj/portal/IntelPremierSupportUser)

Please remember to register your product at https://registrationcenter.intel.com/ by providing your email address. Registration entitles you to free technical support, product updates and upgrades for the duration of the support term. It also helps Intel recognize you as a valued customer in the support forum.

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1 Introduction

Intel® SoC Watch is a command line tool for monitoring system behaviors related to power consumption on Intel® architecture-based platforms. It monitors power states, frequencies, bus activity, wakeups, and various other metrics that provide insight into the system's energy efficiency. This document provides system requirements, installation instructions, issues and limitations, and legal information.

Intel SoC Watch supports the Intel platforms code named Braswell, Bay Trail, CherryTrail, Broadwell, Haswell, Skylake, Kaby Lake, and Apollo Lake. Intel SoC Watch specifically supports the Intel SoCs code named CherryView and ValleyView2. See System Requirements for further details on supported platforms.

To learn more about this product, see:

- New features listed in the New in this Release section below, or in the help.
- Reference documentation listed in the Related Documentation section below
- Installation instructions can be found at: Installation Notes
- For a detailed quick start guide to running the tool, see the Intel SoC Watch User's Guide in your installed documentation.

2 New in This Release

- New features:
  - `pkg-temp` on Intel platforms code named Apollo Lake: Measure the thermal status of multiple domains in the package.
  - `dram-bw` on Intel platforms code named Apollo Lake: Reports total DDR bandwidth with memory slice breakdown.

3 Known Issues

Intel VTune Amplifier 2017 for Systems visualization

- **Intel VTune Amplifier 2017 Update 1 for Systems or later is required for visualizing and analyzing Intel SoC Watch v2.3 PWR files.** We recommend using the latest version of Intel VTune Amplifier for Systems whenever possible (currently Intel VTune Amplifier 2017, Update 1).
- ACPI S3 data collected by Intel SoC Watch v2.3 cannot be imported and visualized in Intel VTune Amplifier 2017 for Systems in default mode. To visualize this data, use the new generic import experimental mode.
- If the bandwidth is 0 Mb throughout the collection for a particular metric, Intel VTune Amplifier will not show a timeline entry for it. The timeline is shown only if there is at least one non-zero value.
- Sometimes the summary CSV results produced by Intel SoC Watch do not match exactly the summary results shown by Intel VTune Amplifier for Systems even though they represent the same collection. For example, the summary CSV file may report a specific cpu-pstate residency of 50.78% and Intel VTune Amplifier for Systems may report the same cpu-pstate residency as 50.8%.
- Intel VTune Amplifier for Systems currently does not support bandwidth ranges used for ReadPartial and WritePartial. In order to keep the visualization consistent with Intel SoC Watch v1.x, Intel VTune Amplifier uses the upper bound of the range to visualize the bandwidth.
- Bandwidths displayed in Intel VTune Amplifier for Systems will not exactly match the bandwidths from the collector summary file. The collector is dividing by 10^6 to generate MB data. Intel VTune Amplifier for Systems is dividing by 1024*1024 to generate MiB data. The calculations have unified using the MB convention as of Intel VTune Amplifier for Systems 2016, Update 1.
- Intel VTune Amplifier C-State visualization has been adjusted to match the Intel SoC Watch 2.3 *summary* CSV naming convention for C-States. Core C-states are now prepended with a C – e.g. CC0, CC1, CC2,…, Module C-States are prepended with an M – e.g. MC0, MC1, MC2,…, Package C-States are prepended with a P – e.g. PC0, PC1, PC2,…, and Graphics C-States are prepended with an R – e.g. RC0, RC1, RC2… Intel SoC Watch v1.x and Intel SoC Watch v2.3 results previously imported into an older version of Intel VTune Amplifier need to be re-resolved in Intel VTune Amplifier 2017 for Systems for the change to take effect. Simply click on the **Analysis Type** tab and click on the **Re-resolve** button.
- The Intel SoC Watch v2.3 `ddr-bw` feature measures both bandwidth and bandwidth requests on Intel platforms code named Haswell, or Broadwell. When this data is imported and visualized with Intel VTune Amplifier for Systems, only actual bandwidth is shown.

Bandwidth and DRAM Self Refresh

- **Intel SoC Watch v2.x.0 requires loading the socperf v2.0 driver in order to measure bandwidths or DRAM self-refresh. Use the –v switch to determine which version of the socperf driver is *loaded*. If a mismatch occurs (socperf v1.2.0 used with socwatch >=v2.0.0), Intel SoC Watch will report *-1, SOCPERF ERROR configuring SOCPERF interface….***
- On a very small number of systems, results from the `all-approx-bw` feature may be one half of the correct result. During testing, this issue was only experienced on the first

collection after the system was booted. All subsequent collections correctly measured the systems bandwidth as expected.

- If Intel SoC Watch crashes while collecting a bandwidth feature (e.g. `–f ddr-bw`) or the DRAM self-refresh feature (i.e. `–f dram-srr`) AND a subsequent collection prints the following error

  ERROR: ERROR configuring SOCPERF interface!

  then both the socperf2_0.ko and socwatch2_2.ko kernel modules must be unloaded with the rmmod command and reloaded with the insmod command before Intel SoC Watch can be used to collect additional data.
- When measuring DRAM self refresh using the -f dram-srr feature on cost reduced systems (e.g. Bay Trail cost reduced or CherryTrail cost reduced), Intel SoC Watch *may* report 100% self refresh residency on Channel 1. These systems are single channel systems and therefore, the result should be 0%.
- Recent ValleyView2 FFRD-8 and FFRD-8 CR devices use UEFI BIOS. The BIOS needs to be configured to put the device in Perf mode before bandwidth and DRAM self refresh measurements can be made. Detailed instructions are here.
- Only one bandwidth (`ddr-bw, cpu-ddr-mod0-bw, cpu-ddr-mod1-bw, io-bw, disp-ddr-bw, gfx-ddr-bw, isp-ddr-bw, all-approx-bw`) or DRAM self refresh (`dram-srr, dram-srr-ch0, dram-srr-ch1`) can be measured during a collection due to hardware limitations. For example, the following Intel SoC Watch command line will fail. `./socwatch -f ddr-bw -f cpu-ddr-mod0-bw ...`

Miscellaneous

- In order to graph graphics cstates using the filename_trace.csv file generated with the -r int switch, the table headers should be manually modified. *Render* and *Media* should be added to the C0, C1, and C6 cells as appropriate in order to properly graph the results.
- The `graphics-cstate` metric is obtained by frequently polling GPU counters that provide the `gfx-cstate` residencies. On a few devices, we have noticed that for 1 out of every ~3000 samples the residency of one of the c-states (Render C0, C1, C6 or Media C0, C1, C6) as obtained from the GPU counters is greater than the sample duration by 5% or more. When this happens Intel SoC Watch discards that sample and throws the error, "*ERROR: Residency counter for GPU C-state = xxxx TSC ticks, but actual sample duration = yyy TSC ticks. Difference is more than 5.000000 percent.*" The error by itself is non-fatal and Intel SoC Watch results give a good idea about the gfx-cstate residencies since the bad sample is collected only 1 out of ~3000 samples. This issue is being investigated further.
- Intel SoC Watch reads PMIC and Skin Temperatures from the system's sysfs. Rarely, a sysfs read may not return before a subsequent sysfs read occurs. When this occurs, specific sample results may be missing in the timed trace CSV and raw text files.
- Intel SoC Watch may collect longer than specified with the –t switch. This is a known issue and will be corrected in a future release.
- On CherryView A stepping based systems, Intel SoC Watch measures all core and SoC temperatures as 110 degrees C. This is a known issue in the A stepping hardware and has been corrected in the CherryView B stepping hardware.
- Core off-lining or on-lining ***during*** a collection is not supported.
- Users should not try to correlate S0ix or screen state (on | off) with NC GFX IP block states. Instead, confirm the NC Gfx IP block results by correlating with the gfx-pstate results.

- If socperf reads occur before the start of collection, a dmesg error message is generated: “socperf2_0: [ERROR] ERROR: RETURNING EARLY from Read_Data”. This message is benign and can safely be ignored.
- An improvement in overhead test methodology revealed that the default Intel SoC Watch collection is not meeting the <5% power overhead limit that we have set for ourselves. To counteract this, we have developed the new `--low-overhead` mode. See the User Guide for details. The `--low-overhead` mode will be turned on by default in a future version.
- Some metrics may not be present in the HTML output file [584]. This issue is sporadic.
- An issue may cause system instabilities when running Intel SoC Watch collections for longer than 5 minutes in Intel platforms code named Apollo Lake. This issue is under investigation. Users are advised not to run Intel SoC Watch collections longer than 5 minutes on this platform.
- Permission issues with SELinux will cause Intel SoC Watch collection to fail. Some distributions enable SELinux by default. If you have the following file your system may have SELinux enabled:
  `/selinux/enforce`

  If that file exists, you can disable by issuing:
  `‘echo 0 > /selinux/enforce`

C-States / P-States

- When a system experiences high temperatures, the IA cores may be forced to execute at a slower frequency due to throttling. Intel SoC Watch does not get notified when this situation occurs. Therefore, Intel SoC Watch may report higher than expected cpu-pstate results. If you suspect this issue, read the sysfs path /sys/devices/system/cpu/cpu**X**/thermal_throttle/core_throttle_count before and after the collection to determine if throttling occurred during the collection.
- If all cores in a module request C6FS but actual sleep time is short, hardware's Auto-Demotion logic resolves the module state to module C0. Consequently, you may find module C0 to be greater than the sum of core C0 and C1 on all the cores in a module. On the same lines (auto demotion at the package level), the package C0 may be greater than module C0 residencies of the two modules.
- During the transition time from core C1/C1e/C6 to core C0, a core may run in LFM which will be properly measured by Intel SoC Watch. Therefore, results that include a large number of C1/C1e/C6 residencies may show a lower PState than expected.
- On ValleyView2 based systems, the Gen gfx cstate counters are not saved and restored across S0ix transitions. Therefore, if the system enters S0i1-3 during a collection, the `gfx-cstate` results will be corrupted.

S States & D States

- When the `–f sstate` switch is specified, Intel SoC Watch generates a summary table that describes both the system’s ACPI S3 and S0ix behavior. The table may show the S0 column first or the S3 column first. For example,

  S3 S0 Total

s0i0	0.00%	99.98%	99.98%
s0i1Audio	0.00%	0.00%	0.00%
s0i1	0.00%	0.00%	0.00%
s0i2	0.00%	0.00%	0.00%
s0i3	0.00%	0.00%	0.00%
Total	0.00%	99.98%	

	S0	S3	Total
s0i0	100.00%	0.00%	100.00%
s0i1Audio	0.00%	0.00%	0.00%
s0i1	0.00%	0.00%	0.00%
s0i2	0.00%	0.00%	0.00%
s0i3	0.00%	0.00%	0.00%
Total	100.00%	0.00%	

- On Intel platforms code named CherryView-based devices, even when the device's screen is off, the NC DState called Display DPIO is reported in the D0i0 state 100% of the time. This result may or may not be correct.
- When collecting NC D0ix states with the `-f nc-dstate` switch, note that the Display Island B (HDMI) IP block will remain in D0i0 when the primary display is enabled even if an HDMI cable is removed.
- When using the `sc-dstate` feature on Intel platforms code named CherryTrail or Braswell based systems, the SEC IP block results are incorrect and should be ignored. This issue is under investigation. Also, the UFS IP block results are incorrect because an internal fuse is disabled.

4 System Requirements

4.1.1 Supported Architectures

Intel SoC Watch for Linux* OS works on systems based on the following platforms:

- Next-Generation 22nm Intel® Atom™ Processor-based SoC for Tablets and 2-in-1s (formerly code named Bay Trail)
- Next-generation 22nm quad-core Intel Atom SoC for tablets (formerly code named Merrifield)
- 4th generation Intel Core™ processor-based Ultrabook (formerly code named Harris Beach)
- Intel Atom Processor Z35XX (formerly code named Moorefield)
- Intel platform code named Cherry Trail
- Intel platform code named Apollo Lake
- Intel SoC Watch supports Core systems starting with Intel Core platforms code named Haswell and Intel Atom platforms code named Silvermont

4.1.2 Dependencies

Intel SoC Watch depends on specific OS configurations and hardware capabilities. If these are not present on the target system, Intel SoC Watch may fail to work properly.

- Linux Kernel version needs to be >= 2.6.32
- GNU C Library must by version GLIBC_2.17 or later
- KERNEL_CONFIG_TRACEPOINTS must be enabled
- Kernel must have been compiled with "CONFIG_MODULES" enabled.
- P States
    - Kernel config CONFIG_X86_SFI_CPUFREQ or CONFIG_X86_ACPI_CPUFREQ must be enabled (i.e. set to 'y' or 'm').
    - One of the following pstate drivers must be utilized: sfi-cpufreq, acpi-cpufreq, or intel_pstate. To determine which driver is loaded, check the sysfs /sys/devices/system/cpu/cpu0/cpufreq/scaling_driver file.
    - If one of these pstate drivers is not loaded, the kernel needs to be reconfigured and recompiled.
- C States
    - Kernel config CONFIG_TIMER_STATS must be enabled.
    - Kernel config CONFIG_INTEL_IDLE must be enabled and the intel_idle kernel module has to support the target platform's core.
    - To determine if the intel_idle kernel module is loaded, check the sysfs /sys/devices/system/cpu/cpuidle/current_driver file. It must equal intel_idle. If it equals acpi_idle, only C0 and C1 will be used by the core.

4.1.3 Available Metrics

Atom-based Platforms			
Platform Name		**Braswell**	**Bay Trail**
SoC		**CherryView**	**ValleyView2**
Feature Switch	**Collection Method**		
all-approx-bw	poll	x	x
core-temp	poll	x	x
cpu-cstate	trace	x	x
cpu-ddr-mod0-bw	poll	x	x
cpu-ddr-mod1-bw	poll	x	x
cpu-pstate	trace	x	x
ddr-bw	poll	x	x
disp-ddr-bw	poll	x	x
dram-srr	poll	x	x
gfx-cstate	poll	x	x
gfx-ddr-bw	poll	x	x
gfx-pstate	poll	x	x
io-bw	poll	x	x
isp-ddr-bw	poll	x	x
nc-dstate	poll	x	x
pmic-temp	poll	x	x
sc-dstate	poll	x	
sstate	snapshot	x	x
skin-temp	poll	x	x
soc-temp	poll	x	x

Core-based Platforms					
Platform Name		**Broadwell**	**Haswell**	**Skylake**	**Kaby Lake**
SoC		**Broadwell**	**Haswell**	**Skylake**	**Kaby Lake**
Feature Switch	**Collection Method**				
core-temp	poll	x	x	x	x
cpu-cstate	snapshot, trace	x	x	x	x
cpu-state	trace	x	x	x	x
gfx-cstate	poll	x	x	x	x
gfx-pstate	poll			x	x
ddr-bw	poll	x	x	x	x
Sstate	poll	x	x	x	x

5 Intel® System Studio Installation Notes

To install Intel SoC Watch for Linux* OS, you will need to install Intel System Studio 2017 Update 1. This will also install Intel VTune Amplifier 2017 for Systems which is the minimum version of Intel VTune Amplifier for Systems required to visualize/analyze data collected by Intel SoC Watch v2.3 (PWR files).

In order to visualize Intel SoC Watch v2.3 results with Intel VTune Amplifier 2017 for Systems, use the -r vtune switch during a collection or to post-process an existing SW2 file to generate a PWR file. Copy the PWR file to the host for import and visualization with Intel VTune Amplifier 2017 for Systems.

Installing Intel System Studio

Follow the below steps to download and install the Intel System Studio. Note that if you already have an Intel System Studio license, you can skip steps 1 and 2.

1. You will need to have a license for the Intel System Studio. You can purchase that license or receive a 30 day evaluation license from the Intel® Developer Zone. Copy it. Note that your serial number and a license file will also be emailed to you.
2. Once you have a license, go to the Intel Registration Center and log in. If this is the first time logging in to the Intel Registration Center, you will need to register your initial product using the serial number.

3. Once you have a license and have registered the product, it will show up in your product listing. Select the desired version:

Intel® System Studio Professional Edition		
Intel® System Studio Professional Edition (Linux* host – All Tools)	Version 2017 (Initial Release)	29 Aug 2016
Intel® System Studio Professional Edition (Windows* host – All Tools)	Version 2017 (Initial Release)	29 Aug 2016
Intel® HD Graphics Drivers for Linux*	Version 1.0 (16.4.4-47109)	18 Feb 2016
Intel® System Studio Composer Edition (Linux* host)	Version 2017 (Initial Release)	29 Aug 2016
Intel® System Studio Composer Edition (Windows* host)	Version 2017 (Initial Release)	29 Aug 2016
Intel® VTune™ Amplifier for Systems with Intel® Energy Profiler (OS X* Host)	Version 2017 (Initial Release)	29 Aug 2016

4. Launch the installer.
5. When prompted, specify the serial number obtained in step 1 (Internet connection required) or select “Choose alternative activation”, then select “Use a license file” and select the file provided via email in step 1.
6. When updating the product, the license file and the serial number will still work.

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