

AMD μ Prof Release Notes

Release v3.4

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Thank you for using AMD uProf. Please use the [AMD's developer community](#) to provide your feedback. You can check out the User Guide and the AMD uProf blog at [AMD uProf's product page](#).

This version contains (for 64-bit Windows and Linux platforms):

- AMDuProf Graphical User Interface Tool
- AMDuProfCLI Command Line Interface Tool
- AMDuProfPcm Command Line Interface Tool
- AMDProfileController APIs to selectively enable and disable the CPU Profiling during runtime of the profiled application
- AMDPowerProfileAPI library APIs to configure and collect the Power, Frequency and Thermal counters

Highlights of this release v3.4

The following are new features in this release:

- Extended the performance analysis type “Cache Analysis” to Windows to identify potential false cache-line sharing performance issues.
 - A new MEMORY → “Cache Analysis” section to list the cache-line addresses, offsets, and the corresponding function names with profile data.
 - In Preferences section in SETTINGS page, added “Maximum rows to show in Cache Analysis Tree” spinner to specify the number of rows displayed in “Cache Analysis” section.
 - Heatmap support in SOURCE view for Cache Analysis session.
- New platform support for AMD EPYC 3rd generation and Ryzen 5000 series APUs and CPUs
 - All the existing CPU Profiling features on Windows, Linux, and FreeBSD.
 - All the existing Power Profiling features on Windows and Linux.
 - AMD EPYC 3rd generation processor support was tested on following Linux distro versions:
 - SUSE Linux Enterprise Server 15 SP2 - 5.3.18-24.49-default
 - Red Hat Enterprise Linux 8.3 (Ootpa)-64 Kernel - 4.18.0-240.10.1.el8_3.x86_64
- Support for predefined events
 - Predefined events are the combination of event selector and the corresponding unit-masks to monitor the common microarchitecture performance events. These events are denoted by symbolic names.
 - AMDuProf (GUI):
 - The events selector table in the “Custom Profile” section has a new category to list the “Predefined Events”.
 - Added descriptions to these events which will be shown in the tooltip.
 - AMDuProfCLI:
 - Added an option to list the predefined events.
“AMDuProfCLI info --list predefined-events”
 - Added an option to specify the symbolic event names as monitored events while profile data collection.
“AMDuProfCLI collect -e CYCLES_NOT_IN_HALT -e RETIRED_INST --interval 250000 -a -d 30”
 - Added an option to specify the common sampling interval for all the monitored events - *“--interval <sampling interval>”*.
 - Updated the existing -e option to specify the symbolic event names as the monitored events.
“AMDuProfCLI collect -e event=CYCLES_NOT_IN_HALT,interval=100000 -e event=RETIRED_INST,interval=250000 -a -d 30”

- Virtualization support
 - Added Timer based profiling support for the Linux and Windows guest VMs running on the following hypervisors:
 - Microsoft Hyper-V
 - VMware ESXi 7.0
 - Linux KVM
 - Added Core PMC event-based profiling support for the Linux and Windows guest VMs running on the following hypervisors:
 - VMware ESXi 7.0
 - Linux KVM
- AMDuProfPcm – System Analysis
 - Added Windows support.
 - New platform support for AMD EPYC 3rd generation CPUs. Support all the existing features of AMDuProfPcm.
 - Added a new option “-C” to accumulate the metric data and report it at the end of profile duration.
 - Added a new option “-A” to aggregate the metric data at various component levels like system, package, CCD and CCX.
 - Added a new option “-D” to dump the raw event count values.
 - Added support to collect PCIe bandwidth metrics.
 - Virtualization support
 - Support for Linux and Windows guest VMs running on the following hypervisors:
 - Microsoft Hyper-V
 - VMware ESXi 7.0
 - Linux KVM
- Advisory capabilities:
 - Added Confidence threshold functionality - the metric with low number of samples collected for a program unit either due to multiplexing or statical sampling will be grayed out.
 - This is applicable to SW Timer and Core PMC based metrics.
 - This confidence threshold value can be set through “Preferences” section in SETTINGS page.
 - Added Issue threshold functionality - to highlight the CPI metric’s cells exceeding the specific threshold value (>1.0). Those cells will be highlighted in pink to show them as potential performance problem.

- Added a new tool AMDCpuTopology tool to report the CPU topology information of AMD Zen architecture-based CPUs and APUs. This is a Linux only tool.
- Support system wide kernel callstack profiling on Linux and FreeBSD.
- HPC enhancements
 - Added new metrics “Load Imbalance” and “Load Imbalance %” for OpenMP profile.
 - Updated HPC page:
 - Added “Overview” section to show the summary of the OpenMP profile data.
 - “Parallel Regions” table to list the metrics for all the parallel regions. The entries are sorted based on “Load Imbalance” metric values.
 - In “Regions Detailed Analysis” (which shows the thread state timeline as stacked bar chart of all the threads of a parallel region), clicking on a thread in the thread state timeline will highlight the corresponding thread entry in the thread summary table and vice-versa.
 - Limit collecting OMPT trace to 512 unique parallel regions and 512 instances of a unique parallel region. This default can be modified by setting the below OpenMP environment variables to the required values:
 - AMDUPROF_MAX_PR_INSTANCES
 - AMDUPROF_MAX_PR_INSTANCE_COUNT
- Per-event Callstack sampling (CSS) support to reduce sampling overhead on server platforms
 - AMDuProf (GUI):
 - For “Custom Profile” configs the CSS for any event can be enabled from the “Monitored Events” table.
 - For predefined configs use “Modify Events” button to enable or disable the CSS for monitored events.
 - AMDuProfCLI:
 - Added a new attribute(“call-graph”) to -e option to enable CSS for a monitored event.
- CLI enhancements
 - Added a new option (--data-buffer-count <count>) to specify the number of data buffers to be used by the Windows uProf driver. This will help to reduce the missing samples.
 - Added a new attribute (loadstore) to -e option to collect only the load and store IBS OP samples on Windows.
 - Added a new option (--ascii event-dump) to “report” and “translate” commands to generate ASCII dump of IBS OP samples.

- Added a new option (--mmap-pages) to specify the kernel memory mapped data buffer size on Linux. This can be used to reduce the missing samples due to low number of data buffers.
- GUI features and enhancements
 - Added “Function HotSpots” section in ANALYZE page to list the hottest functions across all the processes and load modules.
 - Added context menu items.
 - “Copy selected row(s)” to copy the highlighted row to clipboard.
 - “Copy all rows” to copy all the data rows to clipboard.
 - Added search functionality to search for a specific function with regular expression matching.
 - Added functionality to report the raw Core PMC event values as “Event Count”. The event count is the product of sample count and sampling interval. The “Show Value By” dropdown in various sections can be used to choose this option.
 - Callgraph
 - Added context menu-item “Open Call Graph” in Functions table in ANALYZE → “Metrics” to navigate to the corresponding function entry in the “Call Graph” section.
 - Added context menu-item “Go to Caller/Callee” in Caller and Callee tables to navigate to that function in Call Graph Function table.
 - Navigation to SOURCE view from Call Graph, by double clicking on a function entry.
 - HOME → “Recent Session(s)”
 - The monitored events list will be displayed for every session.
 - Added “Edit options” button to modify the session properties before loading the session DB.
 - HOME → “Import Session”
 - Added toggle switch “Resolve Unknown Functions” while importing a session DB.
 - Added “Root Path to Sources” text input option to specify root path of the sources of the profiled application.
 - SETTINGS page
 - Added “Preferences” options.
 - “Data Buffer Count” spinner to specify the number of data buffers to be used by Windows uProf driver.

- “Confidence Threshold Number” spinner to specify the minimum number of samples to be considered as low confidence metric.
 - “Maximum rows to show in Cache Analysis Tree” spinner to specify the number of rows displayed in MEMORY → “Cache Analysis”.
- Updated “Show Values by” dropdown to include “Event Count” option.
- Added “Source Data” options.
 - Toggle switch “Expand inlined functions” to attribute samples to inlined source code. By default, the samples will be attributed to call line.
 - Added “Path to root of kernel sources” line-edit to specify the root path to kernel sources, on Linux.
- Added icons for HOME and SETTINGS page.
- Added icon to close the currently opened profile session.
- Emit a warning for binary mismatch i.e., the binary used to profile does not match with the binary specified while importing the session DB.
- Updated Process dropdown in various sections to list the entries in “[PID] Process Name” format to make it more meaningful.
- SUMMARY → “Hot Spots”
 - Added “Others” entry in the tables corresponding to the remaining samples that are not attributed to top 5 hottest entries.
 - The percentage for the hottest entries in the pie chart is calculated with respect to the total number of samples.
- SUMMARY → “Session Information”
 - Removed “System Details” section and those details are now reported in “Session Information”.
- Flamegraph
 - Added “Zoom Entire Graph” button for better zooming experience.
 - Optimized Flamegraph generation for complex workloads.
- Remote profiling feature is disabled.
- Inline function processing feature is disabled.

Highlights of previous release v3.3

The following are new features in this release

- Added new Performance Analysis types for HPC application analysis
 - Profiling OpenMP applications (Linux)
 - Profiling MPI applications (Linux)
- Added new Cache Analysis to identify potential false sharing cache lines (Linux)
- Added support for System Analysis (AMDuProfPcm) on Windows
- Support for Linux kernel profiling when kernel debug info is available
- New platform support for AMD Ryzen 4000 series processors
- GUI usability improvements
 - Added heatmap in SOURCE view for easier navigation to hot source lines
 - Improvements to data ANALYSIS views
 - Easier locating of recently profiled configurations from WELCOME page
 - Simplified Windows Symbol Server settings
- Optimizations
 - Optimizations to enable to faster profile data processing
 - Simplified default report format and faster report generation
- Potential fix in AMDPowerProfiler Windows driver to avoid a BSOD

Highlights of previous release v3.2

The following are new features in this release

- New platform support for CPU Profiling - AMD EPYC™ 7002 Processor (Rome). Following Linux distro versions are supported.
 - RHEL 8.0.2 or later
Update 2 of RHEL 8 is requires kernel-4.18.0-80.7.1.el8 or later. Refer:
<https://access.redhat.com/support/policy/amd>
<https://access.redhat.com/errata/RHSA-2019:1959>
 - CentOS 8.0.1905 with kernel version kernel-4.18.0-80.7.1.el8 or later
 - Ubuntu 19.10
- Older kernel versions may lead to following NMI error messages emitted on the console:
kernel: Uhhuh. NMI received for unknown reason 3d on CPU 1.
kernel: Do you have a strange power saving mode enabled?
kernel: Dazed and confused, but trying to continue
 - Distros that may lead to this issue
 - SLES 15 SP1
 - RHEL 8 and older
 - CentOS 8.0.1905 and older
- Ubuntu
- CPU Profiling
 - On Linux, performance improvements while data processing and report generation

- On Linux, reduction in the memory consumption during data processing and report generation.
- Improvements in attributing callstack samples.
- On Linux, support profiling for non-root users, when the `perf_event_paranoid` is not set to -1 and ≤ 2 .
- AMDuProfCLI option changes:
 - Replaced the AMDuProfCLI report command's `--no-inline` to `--inline`. Reporting of inlined functions in C, C++ executables is turned off by default. Using `--inline` option will report the inlined functions.
 - Added new option `--show-sys-src` to generate the detailed function report of the system module functions with source statements, if the debug information is available for those system modules.
 - Added a new option `--tid` to `collect` command to profile only the given thread id, on Linux.
 - Added new AMDuProfCLI option `--list` to `info` command to list the supported:
 - predefined collect profile configuration (`collect-configs`)
 - report data view configurations (`view--configs`)
 - raw PMC events that can be used with collect command (`--pmu-events`)
 - Add new options like `--collect-config`, `--view-config` and `--pmu-event` to AMDuProfCLI's `info` command.
- GUI Improvements
 - Simplified SETTINGS page sections.
 - PREFERENCE window to set the user preferences
 - SYMBOL settings window to specify the symbol paths and symbol servers
 - On Windows, use cache path mentioned with `_NT_SYMBOL_PATH` as default, otherwise use uProf's default download path
 - Persistence of the symbol paths across all the profile runs
 - Consolidated the Live Power profiler specific options in "Select Profile Type" → "System-wide Power Profile (Live)" section of PROFILE page, in a new collapsible pane.
 - Scaling of Thread Concurrency chart to avoid horizontal scroll bar.
 - Flame Graph improvements:
 - Navigating to source view from Flame graph for the functions having self-samples.
 - Visualize Flame graph by sorting based on larger callstack.
 - Performance improvements while constructing the Flame graph.
- Power Profiling

- Support Power profiler on 3rd Gen AMD Ryzen Desktop Processor without a dGPU.
 - Support package temperature counter for Ryzen processors.
 - Disabled the --histogram and --cumulative options of “timechart” command of AMDuProfCLI.
 - Moved CorrelatedPower category counters to Power category for family17h processors.
- Quality and Usability improvements
 - Multiple bug fixes

Highlights of previous minor release v3.1

The following are new features in this release:

- New platform support for Performance and Power profiling
 - AMD EPYC™ 7002 Processor
- Usability Improvements++
 - Easier navigation to Flame Graph window in ANALYZE page
 - By default, expand the Filters and Options collapsible pane in ANALYZE and SOURCE pages
- Quality
 - Bug fixes

Highlights of major release v3.0

- Flame Graph - a callstack trace visualizer to identify hot call-paths
- Support Linux kernel profiling and kernel-space drivers
- Improved symbol discovery for Linux system libraries
- Remote Profiling support:
 - Host OS: Windows & Target OS: Linux
 - Callgraph window in GUI
- New platform support for Performance and Power profiling
 - 3rd Gen AMD Ryzen Desktop Processor
- GUI feature to search function names in ANALYZE page
- New OS support
 - openSUSE Leap 15, SLES 12 & 15
 - Windows 10 (May 2019 Update), Windows Server 2019
- Improved data translation to reduce the time taken to process the raw profile data records
- Linux Power Profiler drivers supports latest Linux kernel version
- Many bug fixes to improve the overall stability of the product

Supported Processors

- CPU Profiling

- All Ryzen, Ryzen PRO, Threadripper APUs and CPUs up to Ryzen 5000 series
- AMD EPYC 1st generation, AMD EPYC 2nd generation and AMD EPYC™ 3rd generation processors
- All the older CPUs and APUs
- Intel Processors (Timer based profiling only)
- Power Profiling:
 - All Ryzen, Ryzen PRO, Threadripper APUs and CPUs up to Ryzen 5000 series
 - AMD EPYC 1st generation, AMD EPYC 2nd generation and AMD EPYC™ 3rd generation processors
 - AMD APUs: Carrizo, Kaveri, Mullins, Temash, Stoney, Bristol
 - AMD dGPUs: Graphics IP 7 GPUs, AMD Radeon 500 Series and FirePro models

Supported Operating Systems

AMD uProf supports the 64-bit version of the following Operating Systems:

- Microsoft Windows
 - Windows 7
 - Windows 10 (including May 2020 Update 20H2)
 - Windows Server 2016
 - Windows Server 2019
- Linux
 - Ubuntu 16.04 & later
 - RHEL 7.0 & later
 - openSUSE Leap 15.0
 - SLES 12 & 15
 - CentOS 7.0 & later

Note: Windows 7 requires Microsoft update KB2999226 <https://support.microsoft.com/en-us/kb/2999226>

System Requirements

AMD µProf contains a host of development features with varying system requirements:

CPU Profiling

- Time-Based Profiling can be performed on any AMD64 (x86-64) CPU/APU.
- The Event-Based Profiling (EBP) and Instruction-Based Sampling (IBS) session types require an AMD CPU or APU.
- CPU Profiling on Linux platforms - Limitations of PERF

- Call chain analysis on Linux currently depends on the call chain information provided by Linux PERF. This requires the profiled binaries to have stack frame pointer (i.e., compiled with `-fno-omit-frame-pointer`).
- For non-root users to perform EBP and System-wide profiling, `"/proc/sys/kernel/perf_event_paranoid"` needs to be set to `"-1"`.
- IBS Profiling on Linux requires Linux kernel 3.5 and above.
- For Zen microarchitecture, EBP and IBS profiling on Linux requires Linux kernel 4.9 and above.
- For AMD Zen 1st generation processor-based systems, IBS might not be enabled by default and needs to be enabled from the BIOS settings.
- MPI Code Profiling support matrix
 - MPI Spec :- MPI-3.1
 - MPI Libraries :- Open MPI v4.1.0, MPICH 3.4.1, ParaStation MPI 5.4.8, Intel MPI 2019
 - OS :- Ubuntu 18.04 LTS, 20.04 LTS, RHEL 8.x, CentOS 8.x
- OpenMP Tracing support matrix
 - OpenMP Spec :- OpenMP v5.0
 - Compiler :- LLVM 8 and above, AOCC 2.1 and above, ICC 19.1
 - Languages :- C, C++, Fortran
 - OS :- Ubuntu 18.04 LTS, 20.04 LTS, RHEL 8.x, CentOS 8.x

Power Profiling

- Power profiling functionality requires AMD Radeon software to be installed on the supported AMD APUs or dGPUs. For getting the latest Radeon software release: Please visit <http://support.amd.com/us/gpudownload/Pages/index.aspx>

Known Issues

CPU Profiling

- CPU Profiling is disabled on Windows OSES if Hyper-V or VBS is enabled.
- PERF call chains which contain call stacks across modules have shown to be truncated. This results in inaccurate "Deep Samples" analysis.
- If AMD μ Prof is installed in path that includes non-ASCII Unicode characters, profiling does not work.
- CPU Profiler doesn't support profiling of Windows Store App.
- CPU Profiler report command invocation with `--symbol-server & --symbol-cache-dir` options crashes if Ctrl-C is pressed.
- CPU Profiler IMIX report may omit instruction-name (by showing empty space) for few instructions.
- Profiling of Java apps running on 32-bit JVM on Linux platform is not supported.
- On Windows, CLR Application profiling doesn't work in this release.
- Profiling Java programs with explicitly specifying the AMD uProf's JVMTI profile agent using Java's `-agentpath` option may lead to empty source view. Users are advised to launch Java under the tool to profile Java programs.

- Profile control API's does not work with C based applications.
- If call-stack has recursive functions, sum of samples of a function in callee table is not same as Inclusive sample of function table for that function. [759, 809]
- On Linux, IBS Fetch profiling shows extremely low number of samples.
- AMDuProfCLI crashes if "Ctrl + C" pressed (to kill the profiling) during system wide profiling on RHEL 7.6. Happens 7 out of 10 times. [2273]
- Call stack info shown on Linux is inaccurate if the callpath includes any PLT jump.[2225]
- Call stack info on Linux is inaccurate if the callpath includes inlined functions and FPO together using 32-bit target application.[1512]
- uProf GUI doesn't release the PDB file handle of the target application after translation, due to which the same application can't be compiled unless uProf GUI is closed. [2042]
- Java callstack samples are not aggregated in call stack for one of the profiled application sample. [3417]
- Segmentation fault while collecting samples for FORTRAN OpenMP application compiled using icc compiler. [2942]
- OpenMP Trace data missing when application profiled in RHEL 7.6. [3178]
- On RHEL8.2, IBS and cache analysis profiles throws NMI errors. [3433]
- AMDuProfPcm reports incorrect CPU topology info on the down cored systems.
- In Cache analysis report, remote catch hit(M) metric may not be reported. [3227]
- While attaching a Java process, sometimes report may show incorrect process name. [3436]
- Adding any event to a saved profile enables CSS for all the events present in it. [4118]
- GUI crashed when tried to view source for kernel sample with imported session providing / as "root path to source". [4058]
- On disabling SMT from OS, Power profile throws "ERROR: The driver failed to start profiling" and goes to infinite loop. [3557]
- "Driver failed to start profiling" error on running profile after making any core offline. [3505]
- On KVM, PMC samples are missing on running a profile with event-based profile. [3495]
- Linux kernel disassembly is not working on system with SLES OS. [3491]
- GUI shows incorrect process name on profiling java application. [3436]
- Self-samples reported in callgraph may not match with IP samples of the corresponding function. [3335]
- Missing IBS samples issue on EPYC processors. [3320]
- OMPT trace data missing when application profiled in RHEL 7.6. [3178]
- icc compiled Fortran application crashed while collecting OMPT traces. [2942]
- Source attribution is broken for Java application on FreeBSD. [2793]
- Unable to profile child process on FreeBSD. [2649]

Power Profiling

- If the profiled station goes into Sleep/Hibernate state during a Power Profiling session, only data collected before hibernation is displayed, and the navigation slider does not respond.

- Fails to collect samples for socket level power and temperature counter when system is down cored. [4112]
- Live Power profile produces no records after setting any core offline. [3504]

Support

- Please use [AMD's Developer Community](#) for bug reports, support, and feature requests.