AMD uProf 4.0 Release Notes

Contents

AMD

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Release Highlights

Version 4.0

CPU Profiling

- New platform support for AMD EPYC™ "Zen4" 9xx4 Series and AMD Ryzen™ 7000 Series CPUs.
- All the existing CPU Profiling features on Windows and Linux.
- Disassembly of AVX-512 instructions.
- Profile data collection without root permission.
- Timer and EBP profiling works with the default */proc/sys/kernel/perf_event_paranoid (2)* to profile any user-space application.
- Timer and EBP profiling require perf_event_paranoid ($<= 1$) to profile the kernel space and perf_event_paranoid ($<= 0$) to profile the entire system.
- IBS profile requires perf_event_paranoid ($<= 0$) due to HW limitations as IBS cannot be configured to profile any specific process.

Live Power Profiling

- New platform support for AMD EPYC™ "Zen4" 9xx4 Series and AMD Ryzen™ 7000 Series CPUs.
- All the existing Power Profiling features on Windows and Linux.

CLI Enhancements

- New collect command option:
  - `--limit-size`: Stop profiling when the collected data file size (in MBs) crosses the limit n.
  - New arguments for `--event` option:
    - cmask: The counter mask.
    - inv: The invert counter mask.
    - ibsopl3miss: Enable IBS OP sample collection only when a l3 miss occurs. Available only on AMD EPYC™ "Zen4" CPUs.
    - ibsfetchl3miss: Enable IBS FETCH sample collection only when a l3 miss occurs. Available only on AMD EPYC™ "Zen4" CPUs and with supported kernel version.

- New report command options:

    – `--report-output`: Write a report to a file. If the path has a *.csv* extension, it is considered as a file path. Otherwise, the path is considered as a directory and the report file is generated in the directory with the default name.

    – `--stdout`: Print the report to a console or terminal.

    – `--retranslate`: Perform the re-translation of the collected data files with a different set of translation options.

GUI Enhancements

- Thread concurrency histogram based on Core PMC based IP samples (in Summary view).
- Thread concurrency timeline to plot the average number of running threads at any point of time (in Function Hotspots view).
- Setting to limit the size of raw profile data to be collected for CPU Profiling.
- Drag and drop for *session.uprof* file to load and show the profiled session.
- Threads drop-down in Flamegraph and Callgraph lists the threads based on hotness.
- Thread and MPI rank-based activity data in time range filter for trace timeline view.
- Translation progress report during raw profile data processing.

AMDuProfPcm

New platform support for AMD EPYC^{TM} "Zen4" 9xx4 Series CPUs:

- All the existing metrics on Windows and Linux.
- Pipeline utilization support.

AMDuProfSys

- New platform support for AMD EPYC^{TM} "Zen4" 9xx4 Series CPUs:
    – All the existing metrics on Windows and Linux (available on the supported kernel version).
    – UMC metrics support.
- Core and L3 metrics support for AMD Ryzen^{TM} 5000 Series platform.

GPU Profiling and Tracing

ROCm 5.2.1 support

Supported Processors

AMD uProf supports the following processors:

- CPU Profiling
  - AMD "Zen4" 9xx4, AMD EPYC^{TM} 7001, AMD EPYC^{TM} 7002, and AMD EPYC™ 7003
  - AMD Ryzen^{TM}, AMD Ryzen^{TM} PRO, AMD Ryzen^{TM} Threadripper^{TM}, 3rd Gen AMD Ryzen^{TM} Desktop processors
  - Processors designed for the x86-64 instruction set
- Power Profiling
  - AMD "Zen4" 9xx4, AMD EPYC^{TM} 7001, AMD EPYC^{TM} 7002, and AMD EPYC^{TM} 7003
  - AMD Ryzen^{TM}, AMD Ryzen^{TM} PRO, AMD Ryzen^{TM} Threadripper^{TM}, and 3rd Gen AMD Ryzen^{TM} Desktop processors
- GPU Profiling and Tracing – AMD Instinct^{TM} MI100 and MI200
- AMDuProfPcm – AMD "Zen4" 9xx4, AMD EPYC^{TM} 7001, AMD EPYC^{TM} 7002, and AMD EPYC^{TM} 7003
- AMDuProfSys – AMD "Zen4" 9xx4, AMD EPYC^{TM} 7002 (Family 17, model 0x30 - 0x3F), and AMD EPYC^{TM} 7003 (Family 19, model 0x0 - 0xF)

Supported Operating Systems

AMD uProf supports the 64-bit version of the following operating systems:

- Microsoft®
  - Windows® 10 (up to 21H2)
  - Windows 11 (21H2)
  - Windows Server 2019
  - Windows Server 2022
- Linux®
  - Ubuntu® 16.04 and later
  - RHEL® 7.0 and later
  - openSUSE® Leap 15.0
  - SLES 12 and 15
  - CentOS 7.0 and later
- FreeBSD® 12.2 and later

For OS support on AMD EPYC^{TM} 7003 Series processors, refer to AMD website (*https://www.amd.com/en/processors/epyc-minimum-operating-system*).

System Requirements

AMD uProf contains a host of development features with different system requirements:

CPU Profiling

- Time-Based Profiling can be performed on AMD and other x86-64-compatible processors.
- 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 Linux perf:
  - For AMD "Zen" microarchitecture processors, EBP and IBS profiling on Linux requires Linux kernel 4.9 and above.
  - Call chain analysis on Linux depends on the call chain information provided by Linux perf. This requires the profiled binaries to have stack frame pointer (that is, compiled with `-fno-omit-frame-pointer`).
  - Timer and EBP profiling works with the default */proc/sys/kernel/perf_event_paranoid (2)* to profile any user-space application.
  - Timer and EBP profiling require perf_event_paranoid (<= 1) to profile the kernel space and perf_event_paranoid (<= 0) to profile the entire system.
  - IBS profile requires perf_event_paranoid (<= 0 due to HW limitations; IBS cannot be configured to profile any specific process.
- IBS may not be enabled by default, check BIOS setting to enable it.

GPU Profiling and Tracing

GPU profiling and tracing uses AMD ROCm 5.2.1. For the steps to install AMD ROCm, refer AMD uProf 4.0 user guide.

OS Tracing

- OS tracing (on Linux) requires BPF Compiler Collection (BCC) and eBPF, refer to AMD uProf 4.0 user guide for the steps to install these dependencies.
- OS tracing requires Linux kernel 4.7 or later, it is recommended to use kernel 4.15 or later.

Known Issues

Installer

- On a Windows system:
  1. with any of Microsoft Visual Studio versions 2019 or 2022 installed, and
  2. where the Microsoft Visual C++ redistributable package was uninstalled for any reason, then
     - o The AMD uProf installation may not detect that the redistributable package is missing and thus fail to install the requisite redistributable package.
     - o AMD recommends that you verify or initiate installation of the Microsoft Visual C++ redistributable package prior to installing AMD uProf on a Windows system.
- On Linux, while upgrading AMD uProf using RPM package installer, the upgrade process might leave some of the folders of previous version in */opt/AMDuProf_<old version>* directory. These previous version files/folders will have no impact on the upgraded version of AMD uProf.

CPU Profiling

- If AMD uProf is installed in a path that includes non-ASCII Unicode characters, profiling does not work.
- The CPU Profiler does not support profiling of a Windows Store App.
- The CPU Profiler report command invocation with --symbol-server & --symbol-cache-dir options may crash if "Ctrl-C" is pressed.
- The CPU Profiler IMIX report may show 'BAD OFFSET' or omit instruction-name (by showing empty space) for a few instructions.
- Profile control APIs do not work with C-based applications.
- The AMD uProf GUI does not release the PDB file handle of the target application after translation. The same application cannot be compiled unless AMD uProf GUI is closed.
- Rarely, core PMC samples may not be collected while profiling on KVM guest environment.
- On an ESXi guest environment, a high number of samples are collected in comparison to the same application running on a bare-metal system.
- Custom profiling with IBS and TBP or EBP events might show zero or lesser samples in the report. To overcome this issue, do not combine IBS with the other profiling events (TBP or EBP) during the custom profiling.
- *libclang-cpp.so* library bundled with AOCC 3.2 is not CXX11 ABI compliant. AMD uProf OS tracing functionality depends on libclang library (with abi cxx11 support). While running applications compiled with AOCC 3.2, the LD_LIBRARY_PATH points to AOCC 3.2 bin/lib

paths and hence, AMD uProf fails with undefined symbols error. This issue is not observed if LD_LIBRARY_PATH is not set to AOCC 3.2 libs.

- Time-based profiling (TBP) may not work as expected (very less samples are shown and only attributed to Windows kernel modules) on Windows 11 (22H2).
- If GUI loses focus for a long time, it may become non-responsive; relaunching the GUI may help in such cases.
- For Java applications running for a long time (more than an hour), the sample data attributed to Java methods might not be accurate.
- IBS and MPI profiling are not recommended to be run concurrently as a very large dataset will accumulate.
- On Windows platform, when CSS is enabled (with/without FPO), 40-50% of timer samples are missing for some target applications.
- On Windows, while importing a session in AMDuProf GUI if only OS tracing data is collected using AMDuProfCLI, the error message "No session found in provided directory/path" will be displayed.
- On Linux, in TIMECHART's thread state analysis view, incorrect plotting may be observed rarely for some of the pthread API calls.
- Threads drop-down may not work in Flamegraph if callstack profiling is enabled with system wide data collection.

Power Profiling

- If the profiled system goes into Sleep/Hibernate state during a Live Power Profiling session, only data collected before hibernation is displayed, and the navigation slider does not respond.
- Live Power Profiling does not stop even after attached target process terminates.
- The following are not supported in Power App Analysis:

  - GUI
  - Importing a session to GUI
  - Family 0x19, model 0x10-0x1F, and 0x60-0x6F

- Changing from **Power Profile (Live)** to **CPU Profile** in the **Select Profile Type** drop-down might not enable the **Start Profile** button.
- An empty config name might be displayed in the *Saved Configurations* page for Power Profile. In such cases, you would not be able to reuse the saved configurations.
- Selecting all the available counters in some configurations may cause the GUI crash.

AMDuProfSys

- If Linux perf does not support DF metrics, you must use the flag `--use-amd-driver` after installing the AMDuProf driver. For more information, refer to the AMD uProf 4.0 user guide.
- In RHEL8.6:
  - The DF data from 2nd socket is missing sometimes.
  - UMC profile data may not be collected properly in some platforms.
- The options `-c` and `-p` cannot be used together in Linux; `-p` option is available only on Linux.
- Obfuscation with `--use-amd-driver` is not supported.

Limitation

CPU Profiling

- CPU Profiling (EBP and IBS) is disabled on Windows platforms when Hyper-V is enabled.
- Profiling of Java apps running on 32-bit JVM on Linux platform is not supported.
- On Linux, IBS Fetch profiling shows extremely low number of samples on AMD "Zen1 and Zen2" generation processors.
- OpenMP Tracing is not supported on RHEL 7.x.
- OpenMP tracing does not support tracing through attach to process.
- OpenMP parallel region name resolution is supported only when OpenMP tracing and CPU Profiling are performed together.
- On Windows, AMD uProf does not support profiling through attach to a process running under different account (for example, SYSTEM, NETWORK, and another user). To profile such a process, launch AMD uProf under the same account as the target process.
- On RHEL8.2, IBS and cache analysis profiles throws NMI errors.
- In Cache analysis report on AMD "Zen3" generation processor, remote cache hit(M) metric may not be reported.
- Importing GPU profile DB is not supported.

Support

For support options, the latest documentation, and downloads refer AMD Developer Central (https://developer.amd.com/amd-uprof/).

Highlights of Prior Releases

Version 3.6

- Remote Profiling
  - Allows you to connect a Windows host to a remote Linux target system and run a profile session
  - Profile data collection and translation can be done on the target machine
  - Report can be visualized on the host machine GUI
  - Live power profile data can also be monitored using the host machine GUI
- HPC
  - Open MPI tracing
  - GUI Duration Filter
  - A region of the entire profile run can be selected for analysis; all the reported data in Function Hotspot view is shown based on the selected region
  - Default granularity of aggregation is 1024ms; configurable to aggregate as low as 1ms
- GUI - Callgraph and Flamegraph
  - Sorted based on thread hotness reported as in percentage (%) across all threads
  - Thread name is shown based on its availability
  - Option ("All Threads") to display samples from the entire process
- GUI
  - Function level IMIX report
  - Settings to cache user space binary and symbols for source view
- CPU Profiling
  - Profiling of Microsoft .NET 5.0/6.0 and .NET framework
  - CLI options for Linux kernel profiling:
    - ○ `--kallsyms-path`
    - ○ `--vmlinux-path`
- OS Tracing
  - Supports trace user and kernel function call count; new CLI options:
    - ○ `--func <module:function-pattern>`
    - ○ `--exclude-func <module:function-pattern>`
  - Thread Concurrency tracing in CLI
- GPU
  - Supports AMD ROCm^{TM} 5.1.1
  - Removed KFD profiling and tracing support

Version 3.5

The following features are available in this release:

- CPU Profiling GUI:
  - Timeline for CPU Profile events and metrics
  - Profile duration filter in timeline
  - Bottom-up view of callstack samples
  - Thread level callgraph support
  - Thread level flamegraph support
- Holistic Analysis (Linux only) – Analyze CPU, GPU, and OS events together in GUI. Following events can be traced and analyzed using the holistic analysis view:
  - OS scheduling event
  - System calls
  - POSIX thread synchronization APIs
  - API and GPU activity tracing for heterogenous application using HIP
  - MPI API event tracing
- OS Tracing (Linux only) – Operating System event analysis:
  - Requires kernel 4.7 or later, confirmed on kernel 4.15 and later.
  - Supports following analysis views in GUI:
    - Thread state analysis
    - Kernel block I/O analysis
  - Supports following event reporting in CLI:
    - Synchronization object summary
    - Kernel block I/O analysis
    - Pagefault analysis
    - Memtrace (memory alloc/dealloc) analysis
  - MPI Tracing (Linux only) – HPC Analysis:
    - Performs tracing of MPI APIs of the applications based on MPICH and derivatives
    - GUI – MPI event timeline view and MPI communication matrix view
    - CLI – Hot MPI APIs, point-to-point communication matrix, and collective APIs
  - GPU Tracing (Linux only)
    - Requires AMD ROCm 4.3 installed
    - Supports accelerators AMD Instinct^{TM} MI100 and MI200
    - Performs HIP, ROCr, and KFD tracing
    - GUI – Offload analysis view
    - CLI – HIP and ROCr API and GPU activities summary
  - GPU Profiling (Linux only) – GPU performance analysis:
    - Requires AMD ROCm 4.3 installed
    - Supports accelerators AMD Instinct^{TM} MI100 and MI200

- o   CLI – Performance statistics at kernel level
- –   AMDuProfSys – System analysis:
  - o   Python-based system analysis tool
  - o   Supported on Linux and Windows
- –   GUI features unavailable in this release:
  - o   Remote Profiling (including CLI)
  - o   Importing of raw data files and symbol resolution during import
  - o   IMIX and OpenMP Regions Detailed Analysis view
  - o   Save and import of Live Power profile DB and Power App analysis
  - o   Usability – Copy to clipboard, navigation through context menu, showing events in saved configuration details, apply global preferences on-the-fly, function search, and reporting progress bar

Version 3.4

The following features are available in this release:

- AMDuProf-3.4.494.exe addresses CVE-2021-26334
- Added new Performance Analysis type called "Cache Analysis" on Windows to identify potential false cache-line sharing performance issues
- New platform support – AMD EPYC^{TM} "Zen3"-based processors
  - –   All the existing CPU Profiling features on Windows and Linux
  - –   All the existing Power Profiling features on Windows and Linux
  - –   AMD EPYC^{TM} 3rd generation processor support was tested on the following Linux distro versions:
    - o   SUSE Linux Enterprise Server 15 SP2 - 5.3.18-24.49-default
    - o   Red Hat Enterprise Linux 8.3 (Ootpa)-64 Kernel - 4.18.0-240.10.1.el8_3.x86_64
- Virtualization support
  - –   Timer based profiling support for the following hypervisors and the Linux and Windows guest operating systems running on:
    - o   Microsoft Hyper-V
    - o   VMware ESXi 7.0
    - o   Linux KVM
  - –   Added Core PMC Event based profiling support for the following hypervisors and the Linux and Windows guest operating systems running on:
    - o   Microsoft Hyper-V + vPMU (Tested on Windows Server vNext/Fe Host and Ubuntu 18.04.5 guest VM)
    - o   VMware ESXi 7.0
    - o   Linux KVM
- AMDuProfPcm – System Analysis
  - –   Windows support

- New platform support – AMD EPYC^{TM} "Zen3"-based processors support all the existing features
- 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 level such as system, package, ccd, and ccx
- Added a new option "-D" to dump the raw event count values
- Added support to collect PCIe bandwidth metrics for AMD EPYC^{TM} "Zen2"-based processors
- Virtualization support
  - o Microsoft Windows Server 2019, AH2020, and AH2021 with Hyper-V enabled
  - o Linux and Windows guest operating systems running on:
    - Microsoft Hyper-V
    - VMware ESXi 7.0
    - Linux KVM
- Advisory Functionality
  - Confidence threshold - GUI grays out the low confidence metrics for a program unit. These are marked, if low number of samples collected for a program unit are due to multiplexing or statical sampling.
    - o This is applicable to SW Timer and Core PMC based metrics.
    - o This confidence threshold value can be set through "Preferences" section in SETTINGS page.
  - Issue threshold – For various program units, if the CPI metric's value exceeds the threshold (>1.0), GUI highlights those metric values in pink as potential performance problem.
- AMDCpuTopology tool (Linux only)
  - Added a new tool AMDCpuTopology on Linux, to report the CPU topology information of AMD "Zen" architecture-based processors.
- Miscellaneous New Features
  - Included selective Callstack profiling support.
  - Enhanced Windows uProf driver to reduce the missing samples during IBS OP data collection and added an option to configure the data buffer size to use in kernel space while collecting profile data - this will reduce the missing samples due to low number of data buffers being used by uProf drivers.
  - Added option to collect and generate ASCII dump of IBS OP samples.
- Quality Improvement
  - Fixed data correlation issues such as wrong functions being reported as hot functions and incorrect demangling of function names.
  - Many more bug fixes to improve the overall quality.
- Fixed Windows driver to reduce the samples being missed during IBS OP data collection.

Version 3.3

The following features are available 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
    - 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.

Version 3.2

The following features are available in this release:

- New platform support for CPU Profiling - AMD EPYC™ 7002 Processor (Rome). The 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. For more information, 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 the following NMI error messages 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

- o CentOS 8.0.1905 and older
- – Ubuntu
- – CPU Profiling
  - o On Linux, performance improvements while data processing and report generation.
  - o On Linux, reduction in the memory consumption during data processing and report generation.
  - o Improvements in attributing callstack samples.
  - o On Linux, support profiling for non-root users, when the perf_event_paranoid is not set to -1 and <=2.
  - o AMDuProfCLI option changes:
    - ▪ Replaced the AMDuProfCLI report command's `--no-inline` to `--inline`. Reporting of the inlined functions in C, C++ executables is turned off by default. Using the `--inline` option will report the inlined functions.
    - ▪ Added the 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 the option `--tid` to the "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 such as `--collect-config`, `--view-config`, and `--pmu-event` to the AMDuProfCLI's info command.
- • GUI Improvements:
  - – Simplified SETTINGS page sections
    - o PREFERENCE window to set the user preferences
    - o SYMBOL settings window to specify the symbol paths and symbol servers
    - o On Windows, use cache path mentioned with _NT_SYMBOL_PATH as default, otherwise, use uProf's default download path
    - o Persistence of the symbol paths across all the profile runs
    - o 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
    - o Scaling of Thread Concurrency chart to avoid horizontal scroll bar.
    - o 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
    - o Power Profiling
      - ▪ Added support power profiler on 3rd Gen AMD Ryzen™ Desktop Processor without a dGPU.

- Added support package temperature counter for AMD Ryzen^{TM} 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

Version 3.1

The following features are available in this release:

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

Version 3.0

The following features are available in this release:

- 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 and Target OS - Linux
  - Callgraph window in GUI
- New platform support for Performance and Power profiling - 3rd Gen AMD Ryzen^{TM} desktop processor
- GUI feature to search function names in ANALYZE page
- New OS support:
  - openSUSE Leap 15, SLES 12 and 15
  - Windows 10 (May 2019 Update) and 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