NVIDIA

USER GUIDE

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User Manual

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Chapter 1. PROFILING FROM THE CLI

1.1. Installing the CLI on Your Target

The Nsight Systems CLI provides a simple interface to collect on a target without using the GUI. The collected data can then be copied to any system and analyzed later.

The CLI is distributed in the Target directory of the standard Nsight Systems download package. Users who want to install the CLI as a standalone tool can do so by copying the files within the Target directory. If you want the CLI output file (.qdstrm) to be auto-converted (to .nsys-rep) after the analysis is complete, you will need to copy the host directory as well.

If you wish to run the CLI without root (recommended mode), you will want to install in a directory where you have full access.

Note that you must run the CLI on Windows as administrator.

1.2. Command Line Options

The Nsight Systems command lines can have one of two forms:

```
nsys [global_option]
```

or

```
nsys [command_switch][optional command_switch_options][application] [optional
 application_options]
```

All command line options are case sensitive. For command switch options, when short options are used, the parameters should follow the switch after a space; e.g. **`-s process-tree`**. When long options are used, the switch should be followed by an equal sign and then the parameter(s); e.g. **`--sample=process-tree`**.

For this version of Nsight Systems, if you launch a process from the command line to begin analysis, the launched process will be terminated when collection is complete, including runs with --duration set, unless the user specifies the --kill none option (details below). The exception is that if the user uses NVTX, cudaProfilerStart/Stop, or hotkeys to control the duration, the application will continue unless --kill is set.

The Nsight Systems CLI supports concurrent analysis by using sessions. Each Nsight Systems session is defined by a sequence of CLI commands that define one or more collections (e.g. when and what data is collected). A session begins with either a start, launch, or profile command. A session ends with a shutdown command, when a profile command terminates, or, if requested, when all the process tree(s) launched in the session exit. Multiple sessions can run concurrently on the same system.

1.2.1. CLI Global Options

Short	Long	Description
-h	--help	Help message providing information about available command switches and their options.
-v	--version	Output Nsight Systems CLI version information.

1.3. CLI Command Switches

The Nsight Systems command line interface can be used in two modes. You may launch your application and begin analysis with options specified to the **`nsys profile`** command. Alternatively, you can control the launch of an application and data collection using interactive CLI commands.

Command	Description
analyze	Post process existing Nsight Systems result, either in .nsys-rep or SQLite format, to generate expert systems report.
cancel	Cancels an existing collection started in interactive mode. All data already collected in the current collection is discarded.
export	Generates an export file from an existing .nsys-rep file. For more information about the exported formats see the /documentation/nsys-exporter directory in your Nsight Systems installation directory.
launch	In interactive mode, launches an application in an environment that supports the requested options. The

Command	Description
	launch command can be executed before or after a start command.
nvprof	Special option to help with transition from legacy NVIDIA nvprof tool. Calling **`nsys nvprof [options]`** will provide the best available translation of **`nvprof [options]`** See **Migrating from NVIDIA nvprof** topic for details. No additional functionality of nsys will be available when using this option. Note: Not available on IBM Power targets.
profile	A fully formed profiling description requiring and accepting no further input. The command switch options used (see below table) determine when the collection starts, stops, what collectors are used (e.g. API trace, IP sampling, etc.), what processes are monitored, etc.
sessions	Gives information about all sessions running on the system.
shutdown	Disconnects the CLI process from the launched application and forces the CLI process to exit. If a collection is pending or active, it is cancelled
start	Start a collection in interactive mode. The start command can be executed before or after a launch command.
stats	Post process existing Nsight Systems result, either in .nsys-rep or SQLite format, to generate statistical information.
status	Reports on the status of a CLI-based collection or the suitability of the profiling environment.
stop	Stop a collection that was started in interactive mode. When executed, all active collections stop, the CLI process terminates but the application continues running.

1.3.1. CLI Analyze Command Switch Options

The **`nsys analyze`** command generates and outputs to the terminal a report using expert system rules on existing results. Reports are generated from an SQLite export of a .nsys-rep file. If a .nsys-rep file is specified, Nsight Systems will look for an accompanying SQLite file and use it. If no SQLite export file exists, one will be created.

After choosing the **analyze** command switch, the following options are available. Usage:

```
nsys [global-options] analyze [options] [input-file]
```

Short	Long	Possible Parameters	Default	Switch Description
	--help	<tag>	none	Print the help message. The option can take one optional argument that will be used as a tag. If a tag is provided, only options relevant to the tag will be printed.
-f	--format	column, table, csv, tsv, json, hdoc, htable, .		Specify the output format of the corresponding report(s). The special name "." indicates the default format for the given output. The default format for console is column, while files and process outputs default to csv. This option may be used multiple times. Multiple formats may also be specified using a comma-separated list (<name[:args...][,name[:args...]...]>). See Report

Short	Long	Possible Parameters	Default	Switch Description
				Scripts for options available with each format.
	--force-export	true, false	false	Force a re-export of the SQLite file from the specified .nsys-rep file, even if an SQLite file already exists.
	--force-overwrite	true, false	false	Overwrite any existing output files.
	--help-formats	<format_name>, ALL, [none]	none	With no argument, list a summary of the available output formats. If a format name is given, a more detailed explanation of the the format is displayed. If **ALL** is given, a more detailed explanation of all available formats is displayed.
	--help-rules	<report_name>, ALL, [none]	none	With no argument, list available rules with a short description. If a rule name is given, a more detailed explanation of the rule is displayed. If **ALL** is given, a

Short	Long	Possible Parameters	Default	Switch Description
				more detailed explanation of all available rules is displayed.
-o	--output	-, @<command>, <basename>, .	-	Specify the output mechanism for the corresponding rule(s). There are three output mechanisms: print to console, output to file, or output to command. This option may be used multiple times. Multiple outputs may also be specified using a comma-separated list. If the given output name is "-", the rule will be displayed on the console. If the output name starts with "@", the output designates a command to run. The command will be executed and the rule output will be piped into the command. Any other output is assumed to be the base

Short	Long	Possible Parameters	Default	Switch Description
				path and name for a file. If a file basename is given, the filename used will be: <basename>_<report&args>.<ou The default base (including path) is the name of the SQLite file (as derived from the input file or --sqlite option), minus the extension. The output "." can be used to indicate the rule should be output to a file, and the default basename should be used. To write one or more rules to files using the default basename, use the option: "--output .". If the output starts with "@", the rule is output to the given command. The command is run, and the output of the rule is piped to the command's stdin (standard-input). The command's stdout and

Short	Long	Possible Parameters	Default	Switch Description
				stderr remain attached to the console, so any output will be displayed directly to the console. Be aware there are some limitations in how the command string is parsed. No shell expansions (including *, ?, [], and ~) are supported. The command cannot be piped to another command, nor redirected to a file using shell syntax. The command and command arguments are split on whitespace, and no quotes (within the command syntax) are supported. For commands that require complex command line syntax, it is suggested that the command be put into a shell script file, and the script designated

Short	Long	Possible Parameters	Default	Switch Description
				as the output command.
-q	--quiet			Do not display verbose messages, only display errors.
-r	--rule	cuda-async-memcpy, cuda-sync-memcpy, cuda-sync-memset, cuda-sync-api, gpu-starv, gpu-low-util, dx12-mem-op	all	Specify the rules(s) to execute, including any arguments. This option may be used multiple times. Multiple reports may also be specified using a comma-separated list. See **Expert Systems** section and --help-rules switch for details on all rules.
	--sqlite	<file.sqlite>		Specify the SQLite export filename. If this file exists, it will be used. If this file doesn't exist (or if --force-export was given) this file will be created from the specified .nsys-rep file before report processing. This option cannot be used if the specified input

Short	Long	Possible Parameters	Default	Switch Description
				file is also an SQLite file.
	--timeunit	nsec, nanoseconds, usec, microseconds, msec, milliseconds, seconds	nanoseconds	Set basic unit of time for all rules. The argument of the switch is matched by using the longest prefix matching. Meaning that it is not necessary to write a whole word as the switch argument. It is similar to passing a ":time=<unit>" argument to every formatter, although the formatter uses more strict naming conventions. See "nsys analyze --help-formats column" for more detailed information on unit conversion.

1.3.2. CLI Cancel Command Switch Options

After choosing the **`cancel`** command switch, the following options are available. Usage:

```
nsys [global-options] cancel [options]
```

Short	Long	Possible Parameters	Default	Switch Description
	--help	<tag>	none	Print the help message. The option can take

Short	Long	Possible Parameters	Default	Switch Description
				one optional argument that will be used as a tag. If a tag is provided, only options relevant to the tag will be printed.
	--session	<session identifier>	none	Cancel the collection in the given session. The option argument must represent a valid session name or ID as reported by **`nsys sessions list`**. Any **`%q{ENV_VAR}`** pattern in the option argument will be substituted with the value of the environment variable. Any **`%h`** pattern in the option argument will be substituted with the hostname of the system. Any `%%` pattern in the option argument will be substituted with `%`.

1.3.3. CLI Export Command Switch Options

After choosing the **`export`** command switch, the following options are available. Usage:

```
nsys [global-options] export [options] [nsys-rep-file]
```

Short	Long	Possible Parameters	Default	Switch Description
-f	--force-overwrite	true, false	false	If true, overwrite all existing result files with same output filename (QDSTRM, nsys-rep, SQLITE, HDF, TEXT, ARROW, JSON).
	--help	<tag>	none	Print the help message. The option can take one optional argument that will be used as a tag. If a tag is provided, only options relevant to the tag will be printed.
-l	--lazy	true, false	true	Controls if table creation is lazy or not. When true, a table will only be created when it contains data. This option will be deprecated in the future, and all exports will be non-lazy. This affects SQLite, HDF5, and Arrow exports only.

Short	Long	Possible Parameters	Default	Switch Description
-o	--output	<filename>	<inputfile.ext>	Set the .output filename. The default is the input filename with the extension for the chosen format.
-q	--quiet	true, false	false	If true, do not display progress bar
	--separate-strings	true,false	false	Output stored strings and thread names separately, with one value per line. This affects JSON and text output only.
-t	--type	arrow, hdf, info, json, sqlite, text	sqlite	Export format type. HDF format is supported only on x86_64 Linux and Windows
	--ts-normalize	true, false	false	If true, all timestamp values in the report will be shifted to UTC wall-clock time, as defined by the UNIX epoch. This option can be used in conjunction with the --ts-shift option, in which case both adjustments will be applied. If this option is

Short	Long	Possible Parameters	Default	Switch Description
				used to align a series of reports from a cluster or distributed system, the accuracy of the alignment is limited by the synchronization precision of the system clocks. For detailed analysis, the use of PTP or another high-precision synchronization methodology is recommended. NTP is unlikely to produce desirable results. This option only applies to Arrow, HDF5, and SQLite exports.
	--ts-shift	signed integer, in nanoseconds	0	If given, all timestamp values in the report will be shifted by the given amount. This option can be used in conjunction with the --ts-normalize option, in which case both adjustments will be applied. This option can be used to "hand-align"

Short	Long	Possible Parameters	Default	Switch Description
				report files captured at different times, or reports captured on distributed systems with poorly synchronized system clocks. This option only applies to Arrow, HDF5, and SQLite exports.

1.3.4. CLI Launch Command Switch Options

After choosing the **`launch`** command switch, the following options are available. Usage:

```
nsys [global-options] launch [options] <application> [application-arguments]
```

Short	Long	Possible Parameters	Default	Switch Description
-b	--backtrace			WARNING: This switch is no longer supported. Please set the --backtrace switch when using the start command instead.
	--clock-frequency-changes	true, false	false	Collect clock frequency changes. Available in Nsight Systems Embedded Platforms Edition only.
	--cpu-cluster-events	0x16, 0x17, ..., none	none	Collect per-cluster Uncore PMU counters. Multiple values

Short	Long	Possible Parameters	Default	Switch Description
				can be selected, separated by commas only (no spaces). Use the --cpu-cluster-events=help switch to see the full list of values. Available in Nsight Systems Embedded Platforms Edition only.
	--command-file	< filename >	none	Open a file that contains launch switches and parse the switches. Note additional switches on the command line will override switches in the file. This flag can be specified more than once.
	--cpu-core-events (Nsight Systems Embedded Platforms Edition)	0x11,0x13,...,none	none	Collect per-core PMU counters. Multiple values can be selected, separated by commas only (no spaces). Use the **`--cpu-core-events=help`** switch to see the full list of values.
	--cpu-socket-events	0x2a, 0x2c, ..., none	none	Collect per-socket Uncore PMU counters. Multiple values

Short	Long	Possible Parameters	Default	Switch Description
				can be selected, separated by commas only (no spaces). Use the --cpu-socket-events=help switch to see the full list of values. Available in Nsight Systems Embedded Platforms Edition only.
	--cpuctxsw			WARNING: This switch is no longer supported. Please set the --cpuctxsw switch when using the start command instead.
	--cuda-flush-interval	milliseconds	See description	Set the interval, in milliseconds, when buffered CUDA data is automatically saved to storage. CUDA data buffer saves may cause profiler overhead. Buffer save behavior can be controlled with this switch. If the CUDA flush interval is set to 0 on systems running CUDA 11.0 or newer,

Short	Long	Possible Parameters	Default	Switch Description
				buffers are saved when they fill. If a flush interval is set to a non-zero value on such systems, buffers are saved only when the flush interval expires. If a flush interval is set and the profiler runs out of available buffers before the flush interval expires, additional buffers will be allocated as needed. In this case, setting a flush interval can reduce buffer save overhead but increase memory use by the profiler. If the flush interval is set to 0 on systems running older versions of CUDA, buffers are saved at the end of the collection. If the profiler runs out of available buffers, additional buffers are allocated as

Short	Long	Possible Parameters	Default	Switch Description
				needed. If a flush interval is set to a non-zero value on such systems, buffers are saved when the flush interval expires. A cuCtxSynchronize call may be inserted into the workflow before the buffers are saved which will cause application overhead. In this case, setting a flush interval can reduce memory use by the profiler but may increase save overhead. For collections over 30 seconds an interval of 10 seconds is recommended. Default is 10000 for Nsight Systems Embedded Platforms Edition and 0 otherwise.
	--cuda-memory-usage	true, false	false	Track the GPU memory usage by CUDA kernels. Applicable only when CUDA tracing is enabled. Note:

Short	Long	Possible Parameters	Default	Switch Description
				This feature may cause significant runtime overhead.
	--cuda-um-cpu-page-faults	true, false	false	This switch tracks the page faults that occur when CPU code tries to access a memory page that resides on the device. Note that this feature may cause significant runtime overhead. Not available on Nsight Systems Embedded Platforms Edition.
	--cuda-um-gpu-page-faults	true, false	false	This switch tracks the page faults that occur when GPU code tries to access a memory page that resides on the host. Note that this feature may cause significant runtime overhead. Not available on Nsight Systems Embedded Platforms Edition.
	--cudabacktrace	all, none, kernel, memory, sync, other	none	When tracing CUDA APIs, enable the collection of

Short	Long	Possible Parameters	Default	Switch Description
				a backtrace when a CUDA API is invoked. Significant runtime overhead may occur. Values may be combined using ','. Each value except 'none' may be appended with a threshold after ':'. Threshold is duration, in nanoseconds, that CUDA APIs must execute before backtraces are collected, e.g. 'kernel:500'. Default value for each threshold is 1000ns (1us). Note: CPU sampling must be enabled. Note: Not available on IBM Power targets.
	--cuda-graph-trace	graph, node	graph	If 'graph' is selected, CUDA graphs will be traced as a whole and node activities will not be collected. This will reduce overhead to a minimum, but requires

Short	Long	Possible Parameters	Default	Switch Description
				CUDA driver version 515.43 or higher. If 'node' is selected, node activities will be collected, but CUDA graphs will not be traced as a whole. This may cause significant runtime overhead. Default is 'graph' if available, otherwise default is 'node'.
	--dx-force-declare-adapter-removal-support	true, false	false	The Nsight Systems trace initialization involves creating a D3D device and discarding it. Enabling this flag makes a call to DXGIDeclareAdapterRemovalS before device creation.
	--dx12-gpu-workload	true, false, individual, batch, none	individual	If individual or true, trace each DX12 workload's GPU activity individually. If batch, trace DX12 workloads' GPU activity in ExecuteCommandLists

Short	Long	Possible Parameters	Default	Switch Description
				call batches. If none or false, do not trace DX12 workloads' GPU activity. Note that this switch is applicable only when --trace=dx12 is specified. This option is only supported on Windows targets.
	--dx12-wait-calls	true, false	false	If true, trace wait calls that block on fences for DX12. Note that this switch is applicable only when --trace=dx12 is specified. This option is only supported on Windows targets.
-e	--env-var	A=B	NA	Set environment variable(s) for the application process to be launched. Environment variables should be defined as A=B. Multiple environment variables can be specified as A=B,C=D.

Short	Long	Possible Parameters	Default	Switch Description
	--help	<tag>	none	Print the help message. The option can take one optional argument that will be used as a tag. If a tag is provided, only options relevant to the tag will be printed.
	--hotkey-capture	'F1' to 'F12'	'F12'	Hotkey to trigger the profiling session. Note that this switch is applicable only when --capture-range=hotkey is specified at the start of the profiled session.
-n	--inherit-environment	true, false	true	When true, the current environment variables and the tool's environment variables will be specified for the launched process. When false, only the tool's environment variables will be specified for the launched process.
	--injection-use-detours	true,false	true	Use detours for injection. If false, process injection will be

Short	Long	Possible Parameters	Default	Switch Description
				performed by windows hooks which allows to bypass anti-cheat software.
	--isr	true,false	Trace Interrupt Service Routines (ISRs) and Deferred Procedure Calls (DPCs). Requires administrative privileges. Available only on Windows devices.	false
	--mpi-impl	openmpi,mpich	openmpi	When using --trace=mpi to trace MPI APIs use --mpi-impl to specify which MPI implementation the application is using. If no MPI implementation is specified, nsys tries to automatically detect it based on the dynamic linker's search path. If this fails, 'openmpi' is used. Calling --mpi-impl without --trace=mpi is not supported.
	--nic-metrics	true, false	false	Collect metrics from supported

Short	Long	Possible Parameters	Default	Switch Description
				NIC/HCA devices
-p	--nvtx-capture	range@domain, range, range@*	none	Specify NVTX range and domain to trigger the profiling session. Note that this switch is applicable only when --capture-range=nvtx is specified at the start of the profiled session.
	--nvtx-domain-exclude	default, <domain_names>		Choose to exclude NVTX events from a comma separated list of domains. 'default' filters the NVTX default domain. A domain with this name or commas in a domain name must be escaped with '\'. Note: Only one of --nvtx-domain-include and --nvtx-domain-exclude can be used. This option is only applicable when --trace=nvtx is specified.
	--nvtx-domain-include	default, <domain_names>		Choose to only include NVTX events

Short	Long	Possible Parameters	Default	Switch Description
				from a comma separated list of domains. 'default' filters the NVTX default domain. A domain with this name or commas in a domain name must be escaped with '\'. Note: Only one of --nvtx-domain-include and --nvtx-domain-exclude can be used. This option is only applicable when --trace=nvtx is specified.
	--opengl-gpu-workload	true, false	true	If true, trace the OpenGL workloads' GPU activity. Note that this switch is applicable only when --trace=opengl is specified. This option is not supported on IBM Power targets.
	--osrt-backtrace-depth	integer	24	Set the depth for the backtraces collected for OS runtime libraries calls.

Short	Long	Possible Parameters	Default	Switch Description
	--osrt-backtrace-stack-size	integer	6144	Set the stack dump size, in bytes, to generate backtraces for OS runtime libraries calls.
	--osrt-backtrace-threshold	nanoseconds	80000	Set the duration, in nanoseconds, that all OS runtime libraries calls must execute before backtraces are collected.
	--osrt-threshold	< nanoseconds >	1000 ns	Set the duration, in nanoseconds, that Operating System Runtime (osrt) APIs must execute before they are traced. Values much less than 1000 may cause significant overhead and result in extremely large result files. Default is 1000 (1 microsecond). Note: Not available for IBM Power targets.
	--qnx-kernel-events	class/ event,event,class/ event:mode,class:mode,help,none	none	Multiple values can be selected, separated by

Short	Long	Possible Parameters	Default	Switch Description
				commas only (no spaces). See the --qnx-kernel-events-mode switch description for ':mode' format. Use the '--qnx-kernel-events=help' switch to see the full list of values. Example: '--qnx-kernel-events=8/1:system:wide,_NTO_T __KER_BAD,_NTO_TRACE_CO Collect QNX kernel events.
	--qnx-kernel-events-mode	system,process,fast,wide	system:fast	Values are separated by a colon (':') only (no spaces). 'system' and 'process' cannot be specified at the same time. 'fast' and 'wide' cannot be specified at the same time. Please check the QNX documentation to determine when to select the 'fast' or 'wide' mode. Specify the default mode for QNX kernel events collection.
	--resolve-symbols	true,false	true	Resolve symbols of

Short	Long	Possible Parameters	Default	Switch Description
				captured samples and backtraces.
	--run-as	< username >	none	Run the target application as the specified username. If not specified, the target application will be run by the same user as Nsight Systems. Requires root privileges. Available for Linux targets only.
-s	--sample			WARNING: This switch is no longer supported. Please set the --sample switch when using the start command instead.
	--samples-per-backtrace			WARNING: This switch is no longer supported. Please set the --samples-per-backtrace switch when using the start command instead.
	--sampling-frequency			WARNING: This switch is no longer supported. Please set the --sampling-

Short	Long	Possible Parameters	Default	Switch Description
				frequency switch when using the start command instead.
	--sampling-period			WARNING: This switch is no longer supported. Please set the --sampling-period switch when using the start command instead.
	--sampling-trigger			WARNING: This switch is no longer supported. Please set the --sampling-trigger switch when using the start command instead.
	--session	session identifier	none	Launch the application in the indicated session. The option argument must represent a valid session name or ID as reported by **`nsys sessions list`**. Any **`%q{ENV_VAR}`** pattern will be substituted with the value of the environment variable. Any

Short	Long	Possible Parameters	Default	Switch Description
				%h pattern will be substituted with the hostname of the system. Any %% pattern will be substituted with %.
	--session-new	[a-Z][0-9,a-Z,spaces]	[default]	Launch the application in a new session. Name must start with an alphabetical character followed by printable or space characters. Any **%q{ENV_VAR}** pattern will be substituted with the value of the environment variable. Any **%h** pattern will be substituted with the hostname of the system. Any %% pattern will be substituted with %.
-w	--show-output	true, false	true	If true, send target process's stdout and stderr streams to both the console and stdout/stderr files which are added to the QDSTRM file. If false, only

Short	Long	Possible Parameters	Default	Switch Description
				send target process stdout and stderr streams to the stdout/stderr files which are added to the QDSTRM file.
-t	--trace	cuda, nvtx, cublas, cublas-verbose, cusparse, cusparse-verbose, cudnn, opengl, opengl-annotations, openacc, openmp, osrt, mpi, nvvideo, vulkan, vulkan-annotations, dx11, dx11-annotations, dx12, dx12-annotations, oshmem, ucx, wddm, nvmedia, none	cuda, opengl, nvtx, osrt	Select the API(s) to be traced. The osrt switch controls the OS runtime libraries tracing. Multiple APIs can be selected, separated by commas only (no spaces). Since OpenACC, cuDNN and cuBLAS APIs are tightly linked with CUDA, selecting one of those APIs will automatically enable CUDA tracing. Reflex SDK latency markers will be automatically collected when DX or vulkan API trace is enabled. See information on --mpi-impl option below if mpi is selected. If '<api>-annotations' is selected, the corresponding

Short	Long	Possible Parameters	Default	Switch Description
				API will also be traced. If the none option is selected, no APIs are traced and no other API can be selected. Note: cublas, cudnn, nvvideo, opengl, and vulkan are not available on IBM Power target.
	--trace-fork-before-exec	true, false	false	If true, trace any child process after fork and before they call one of the exec functions. Beware, tracing in this interval relies on undefined behavior and might cause your application to crash or deadlock. Note: This option is only available on Linux target platforms.
	--vulkan-gpu-workload	true, false, individual, batch, none	individual	If individual or true, trace each Vulkan workload's GPU activity individually. If batch, trace Vulkan workloads'

Short	Long	Possible Parameters	Default	Switch Description
				GPU activity in vkQueueSubmit call batches. If none or false, do not trace Vulkan workloads' GPU activity. Note that this switch is applicable only when --trace=vulkan is specified. This option is not supported on QNX.
	--wait	primary,all	all	If primary, the CLI will wait on the application process termination. If all, the CLI will additionally wait on re-parented processes created by the application.
	--wddm-additional-events	true, false	true	If true, collect additional range of ETW events, including context status, allocations, sync wait and signal events, etc. Note that this switch is applicable only when --trace=wddm is specified. This option is

Short	Long	Possible Parameters	Default	Switch Description
				only supported on Windows targets.

1.3.5. CLI Profile Command Switch Options

After choosing the **`profile`** command switch, the following options are available. Usage:

```
nsys [global-options] profile [options] <application> [application-arguments]
```

Short	Long	Possible Parameters	Default	Switch Description
	--accelerator-trace	none,nvmedia	none	Collect other accelerators workload trace from the hardware engine units. Available in Nsight Systems Embedded Platforms Edition only.
	--auto-report-name	true, false	false	Derive report file name from collected data uses details of profiled graphics application. Format: [Process Name] [GPU Name] [Window Resolution] [Graphics API] Timestamp .nsys-rep If true, automatically generate report file names.
-b	--backtrace	auto,fp,lbr,dwarf,none		Select the backtrace method to use while sampling.

Short	Long	Possible Parameters	Default	Switch Description
				The option 'lbr' uses Intel(c) Corporation's Last Branch Record registers, available only with Intel(c) CPUs codenamed Haswell and later. The option 'fp' is frame pointer and assumes that frame pointers were enabled during compilation. The option 'dwarf' uses DWARF's CFI (Call Frame Information). Setting the value to 'none' can reduce collection overhead.
-c	--capture-range	none, cudaProfilerApi, hotkey, nvtx	none	When --capture-range is used, profiling will start only when appropriate start API or hotkey is invoked. If --capture-range is set to none, start/stop API calls and hotkeys will be ignored. Note: Hotkey works for graphic

Short	Long	Possible Parameters	Default	Switch Description
				applications only.
	--capture-range-end	none, stop, stop-shutdown, repeat[:N], repeat-shutdown:N	stop-shutdown	Specify the desired behavior when a capture range ends. Applicable only when used along with --capture-range option. If **`none`**, capture range end will be ignored. If **`stop`**, collection will stop at capture range end. Any subsequent capture ranges will be ignored. Target app will continue running. If **`stop-shutdown`**, collection will stop at capture range end and session will be shutdown. If **`repeat[:N]`**, collection will stop at capture range end and subsequent capture ranges will trigger more collections. Use the optional **`:N`** to specify max number of capture ranges to be honored.

Short	Long	Possible Parameters	Default	Switch Description
				Any subsequent capture ranges will be ignored once N capture ranges are collected. If **repeat-shutdown:N**, same behavior as **repeat:N** but session will be shutdown after N ranges. For **stop-shutdown** and **repeat-shutdown:N**, as always, use --kill option to specify whether target app should be terminated when shutting down session.
	--clock-frequency-changes	true, false	false	Collect clock frequency changes. Available only in Nsight Systems Embedded Platforms Edition and Arm server (SBSA) platforms
	--command-file	< filename >	none	Open a file that contains profile switches and parse the switches. Note additional switches on the command line

Short	Long	Possible Parameters	Default	Switch Description
				will override switches in the file. This flag can be specified more than once.
	--cpu-cluster-events	0x16, 0x17, ..., none	none	Collect per-cluster Uncore PMU counters. Multiple values can be selected, separated by commas only (no spaces). Use the --cpu-cluster-events=help switch to see the full list of values. Available in Nsight Systems Embedded Platforms Edition only.
	--cpu-core-events (Nsight Systems Embedded Platforms Edition)	0x11,0x13,...,none	none	Collect per-core PMU counters. Multiple values can be selected, separated by commas only (no spaces). Use the **`--cpu-core-events=help`** switch to see the full list of values.
	--cpu-core-events (not Nsight Systems Embedded Platforms Edition)	'help' or the end users selected events in the format 'x,y'	'2' i.e. Instructions Retired	Select the CPU Core events to sample. Use the **`--cpu-core-events=help`** switch to see the full list of events and

Short	Long	Possible Parameters	Default	Switch Description
				the number of events that can be collected simultaneously. Multiple values can be selected, separated by commas only (no spaces). Use the --event-sample switch to enable.
	--cpu-socket-events	0x2a, 0x2c, ..., none	none	Collect per-socket Uncore PMU counters. Multiple values can be selected, separated by commas only (no spaces). Use the --cpu-socket-events=help switch to see the full list of values. Available in Nsight Systems Embedded Platforms Edition only.
	--cpuctxsw	process-tree, system-wide, none	process-tree	Trace OS thread scheduling activity. Select 'none' to disable tracing CPU context switches. Depending on the platform, some values may require admin or root privileges. Note: if the --

Short	Long	Possible Parameters	Default	Switch Description
				sample switch is set to a value other than 'none', the --cpuctxsw setting is hardcoded to the same value as the --sample switch. If --sample=none and a target application is launched, the default is 'process-tree', otherwise the default is 'none'. Requires **`--sampling-trigger=perf`** switch in Nsight Systems Embedded Platforms Edition
	--cuda-flush-interval	milliseconds	See Description	Set the interval, in milliseconds, when buffered CUDA data is automatically saved to storage. CUDA data buffer saves may cause profiler overhead. Buffer save behavior can be controlled with this switch. If the CUDA flush interval is set to 0 on systems running CUDA 11.0 or newer,

Short	Long	Possible Parameters	Default	Switch Description
				buffers are saved when they fill. If a flush interval is set to a non-zero value on such systems, buffers are saved only when the flush interval expires. If a flush interval is set and the profiler runs out of available buffers before the flush interval expires, additional buffers will be allocated as needed. In this case, setting a flush interval can reduce buffer save overhead but increase memory use by the profiler. If the flush interval is set to 0 on systems running older versions of CUDA, buffers are saved at the end of the collection. If the profiler runs out of available buffers, additional buffers are allocated as

Short	Long	Possible Parameters	Default	Switch Description
				needed. If a flush interval is set to a non-zero value on such systems, buffers are saved when the flush interval expires. A cuCtxSynchronize call may be inserted into the workflow before the buffers are saved which will cause application overhead. In this case, setting a flush interval can reduce memory use by the profiler but may increase save overhead. For collections over 30 seconds an interval of 10 seconds is recommended. Default is 10000 for Nsight Systems Embedded Platforms Edition and 0 otherwise.
	--cuda-graph-trace	graph, node	graph	If 'graph' is selected, CUDA graphs will be traced as a whole and node activities will not be collected. This will reduce

Short	Long	Possible Parameters	Default	Switch Description
				overhead to a minimum, but requires CUDA driver version 515.43 or higher. If 'node' is selected, node activities will be collected, but CUDA graphs will not be traced as a whole. This may cause significant runtime overhead. Default is 'graph' if available, otherwise default is 'node'.
	--cuda-memory-usage	true, false	false	Track the GPU memory usage by CUDA kernels. Applicable only when CUDA tracing is enabled. Note: This feature may cause significant runtime overhead.
	--cuda-um-cpu-page-faults	true, false	false	This switch tracks the page faults that occur when CPU code tries to access a memory page that resides on the device. Note

Short	Long	Possible Parameters	Default	Switch Description
				that this feature may cause significant runtime overhead. Not available on Nsight Systems Embedded Platforms Edition.
	--cuda-um-gpu-page-faults	true, false	false	This switch tracks the page faults that occur when GPU code tries to access a memory page that resides on the host. Note that this feature may cause significant runtime overhead. Not availalbe on Nsight Systems Embedded Platforms Edition.
	--cudabacktrace	all, none, kernel, memory, sync, other	none	When tracing CUDA APIs, enable the collection of a backtrace when a CUDA API is invoked. Significant runtime overhead may occur. Values may be combined using ','. Each value except 'none' may be appended with

Short	Long	Possible Parameters	Default	Switch Description
				a threshold after ':'. Threshold is duration, in nanoseconds, that CUDA APIs must execute before backtraces are collected, e.g. 'kernel:500'. Default value for each threshold is 1000ns (1us). Note: CPU sampling must be enabled. Note: Not available on IBM Power targets.
-y	--delay	< seconds >	0	Collection start delay in seconds.
-d	--duration	< seconds >	NA	Collection duration in seconds, duration must be greater than zero. The launched process will be terminated when the specified profiling duration expires unless the user specifies the --kill none option (details below).

Short	Long	Possible Parameters	Default	Switch Description
	--duration-frames	60 <= integer		Stop the recording session after this many frames have been captured. Note when it is selected cannot include any other stop options. If not specified, the default is disabled.
	--dx-force-declare-adapter-removal-support	true, false	false	The Nsight Systems trace initialization involves creating a D3D device and discarding it. Enabling this flag makes a call to DXGIDeclareAdapterRemovalS before device creation. Requires DX11 or DX12 trace to be enabled.
	--dx12-gpu-workload	true, false, individual, batch, none	individual	If individual or true, trace each DX12 workload's GPU activity individually. If batch, trace DX12 workloads' GPU activity in ExecuteCommandLists call batches. If none or false, do not trace DX12

Short	Long	Possible Parameters	Default	Switch Description
				workloads' GPU activity. Note that this switch is applicable only when --trace=dx12 is specified. This option is only supported on Windows targets.
	--dx12-wait-calls	true, false	true	If true, trace wait calls that block on fences for DX12. Note that this switch is applicable only when --trace=dx12 is specified. This option is only supported on Windows targets.
	--el1-sampling	true, false	false	Enable EL1 sampling. Available in Nsight Systems Embedded Platforms Edition only.
	--el1-sampling-config	< filepath config.json >	none	EL1 sampling config. Available in Nsight Systems Embedded Platforms Edition only.
-e	--env-var	A=B	NA	Set environment variable(s) for the application process to

Short	Long	Possible Parameters	Default	Switch Description
				be launched. Environment variables should be defined as A=B. Multiple environment variables can be specified as A=B,C=D.
	--etw-provider	"<name>,<guid>", or path to JSON file	none	Add custom ETW trace provider(s). If you want to specify more attributes than Name and GUID, provide a JSON configuration file as as outlined below. This switch can be used multiple times to add multiple providers. Note: Only available for Windows targets.
	--event-sample	system-wide, none	none	Use the --cpu-core-events=help and the --os-events=help switches to see the full list of events. If event sampling is enabled and no events are selected, the CPU Core event 'Instructions

Short	Long	Possible Parameters	Default	Switch Description
				Retired' is selected by default. Not available on Nsight Systems Embedded Platforms Edition.
	--event-sampling-frequency	Integers from 1 to 20 Hz	3	The sampling frequency used to collect event counts. Minimum event sampling frequency is 1 Hz. Maximum event sampling frequency is 20 Hz. Not available in Nsight Systems Embedded Platforms Edition.
	--export	arrow, hdf, json, sqlite, text, none	none	Create additional output file(s) based on the data collected. This option can be given more than once. WARNING: If the collection captures a large amount of data, creating the export file may take several minutes to complete.
-f	--force-overwrite	true, false	false	If true, overwrite all existing result files with same

Short	Long	Possible Parameters	Default	Switch Description
				output filename (.qdstrm, .nsys-rep, .arrows, .h5, .json, .sqlite, .tx
	--ftrace			Collect ftrace events. Argument should list events to collect as: subsystem1/event1,subsystem2/event2. Requires root. No ftrace events are collected by default. Note: Not available on IBM Power targets.
	--ftrace-keep-user-config			Skip initial ftrace setup and collect already configured events. Default resets the ftrace configuration.
	--gpu-metrics-device	GPU ID, help, all, none	none	Collect GPU Metrics from specified devices. Determine GPU IDs by using **`--gpu-metrics-device=help`** switch.
	--gpu-metrics-frequency	integer	10000	Specify GPU Metrics sampling frequency. Minimum supported frequency is 10 (Hz). Maximum supported

Short	Long	Possible Parameters	Default	Switch Description
				frequency is 200000 (Hz).
	--gpu-metrics-set	index, alias		Specify metric set for GPU Metrics. The argument must be one of indices or aliases reported by **`--gpu-metrics-set=help`** switch. If not specified, the default is the first metric set that supports all selected GPUs.
	--gpuctxsw	true,false	false	Trace GPU context switches. Note that this requires driver r435.17 or later and root permission. Not supported on IBM Power targets.
	--help	<tag>	none	Print the help message. The option can take one optional argument that will be used as a tag. If a tag is provided, only options relevant to the tag will be printed.
	--hotkey-capture	'F1' to 'F12'	'F12'	Hotkey to trigger the profiling

Short	Long	Possible Parameters	Default	Switch Description
				session. Note that this switch is applicable only when --capture-range=hotkey is specified.
	--ib-switch-metrics	<IB switch GUIDs>	none	Trigger the collection of IB switch performance metrics. Takes a comma separated list of Infiniband switch GUIDs. To get a list Infiniband switches connected to the machine, use **`sudo ibnetdiscover -S`**
-n	--inherit-environment	true, false	true	When true, the current environment variables and the tool's environment variables will be specified for the launched process. When false, only the tool's environment variables will be specified for the launched process.
	--injection-use-detours	true,false	true	Use detours for injection. If false, process injection will be

Short	Long	Possible Parameters	Default	Switch Description
				performed by windows hooks which allows to bypass anti-cheat software.
	--isr	true, false	false	Trace Interrupt Service Routines (ISRs) and Deferred Procedure Calls (DPCs). Requires administrative privileges. Available only on Windows devices.
	--kill	none, sigkill, sigterm, signal number	sigterm	Send signal to the target application's process group. Can be used with --duration or range markers.
	--mpi-impl	openmpi,mpich	openmpi	When using --trace=mpi to trace MPI APIs use --mpi-impl to specify which MPI implementation the application is using. If no MPI implementation is specified, nsys tries to automatically detect it based on the dynamic linker's search path. If this fails, 'openmpi' is used. Calling

Short	Long	Possible Parameters	Default	Switch Description
				--mpi-impl without --trace=mpi is not supported.
	--nic-metrics	true, false	false	Collect metrics from supported NIC/HCA devices. Not available on Nsight Systems Embedded Platforms Edition.
-p	--nvtx-capture	range@domain, range, range@*	none	Specify NVTX range and domain to trigger the profiling session. This option is applicable only when used along with --capture-range=nvtx.
	--nvtx-domain-exclude	default, <domain_names>		Choose to exclude NVTX events from a comma separated list of domains. 'default' excludes NVTX events without a domain. A domain with this name or commas in a domain name must be escaped with '\'. Note: Only one of --nvtx-domain-include and --nvtx-

Short	Long	Possible Parameters	Default	Switch Description
				domain-exclude can be used. This option is only applicable when --trace=nvtx is specified.
	--nvtx-domain-include	default, <domain_names>		Choose to only include NVTX events from a comma separated list of domains. 'default' filters the NVTX default domain. A domain with this name or commas in a domain name must be escaped with '\'. Note: Only one of --nvtx-domain-include and --nvtx-domain-exclude can be used. This option is only applicable when --trace=nvtx is specified.
	--opengl-gpu-workload	true, false	true	If true, trace the OpenGL workloads' GPU activity. Note that this switch is applicable only when --trace=opengl is specified. This option is not supported

Short	Long	Possible Parameters	Default	Switch Description
				on IBM Power targets.
	--os-events	'help' or the end users selected events in the format 'x,y'	none	Select the OS events to sample. Use the --os-events=help switch to see the full list of events. Multiple values can be selected, separated by commas only (no spaces). Use the --event-sample switch to enable. Not available on Nsight Systems Embedded Platforms Edition.
	--osrt-backtrace-depth	integer	24	Set the depth for the backtraces collected for OS runtime libraries calls.
	--osrt-backtrace-stack-size	integer	6144	Set the stack dump size, in bytes, to generate backtraces for OS runtime libraries calls.
	--osrt-backtrace-threshold	nanoseconds	80000	Set the duration, in nanoseconds, that all OS runtime libraries calls must execute before

Short	Long	Possible Parameters	Default	Switch Description
				backtraces are collected.
	--osrt-threshold	< nanoseconds >	1000 ns	Set the duration, in nanoseconds, that Operating System Runtime (osrt) APIs must execute before they are traced. Values significantly less than 1000 may cause significant overhead and result in extremely large result files. Note: Not available for IBM Power targets.
-o	--output	< filename >	report#	Set report file name. Any %q{ENV_VAR} pattern in the filename will be substituted with the value of the environment variable. Any %h pattern in the filename will be substituted with the hostname of the system. Any %p pattern in the filename will be substituted with the PID

Short	Long	Possible Parameters	Default	Switch Description
				of the target process or the PID of the root process if there is a process tree. Any %% pattern in the filename will be substituted with %. Default is report#.{qdstrm,nsys-rep,sqlite,h5,txt,arrows,json} in the working directory.
	--process-scope	main, process-tree, system-wide	main	Select which process(es) to trace. Available in Nsight Systems Embedded Platforms Edition only. Nsight Systems Workstation Edition will always trace system-wide in this version of the tool.
	--qnx-kernel-events	class/event,event,class/event:mode,class:mode,help,none	none	Multiple values can be selected, separated by commas only (no spaces). See the --qnx-kernel-events-mode switch description for ':mode' format. Use the '--qnx-kernel-events=help' switch to see the full list

Short	Long	Possible Parameters	Default	Switch Description
				of values. Example: '--qnx-kernel-events=8/1:system:wide,_NTO_T _NTO_TRACE_KERCALLENTI __KER_BAD,_NTO_TRACE_CO Collect QNX kernel events.
	--qnx-kernel-events-mode	system,process,fast,wide	system:fast	Values are separated by a colon (':') only (no spaces). 'system' and 'process' cannot be specified at the same time. 'fast' and 'wide' cannot be specified at the same time. Please check the QNX documentation to determine when to select the 'fast' or 'wide' mode. Specify the default mode for QNX kernel events collection.
	--resolve-symbols	true,false	true	Resolve symbols of captured samples and backtraces.
	--retain-etw-files	true, false	false	Retain ETW files generated by the trace, merge and move the files to the output directory.

Short	Long	Possible Parameters	Default	Switch Description
	--run-as	< username >	none	Run the target application as the specified username. If not specified, the target application will be run by the same user as Nsight Systems. Requires root privileges. Available for Linux targets only.
-s	--sample	process-tree, system-wide, none	process-tree	Select how to collect CPU IP/backtrace samples. If 'none' is selected, CPU sampling is disabled. Depending on the platform, some values may require admin or root privileges. If a target application is launched, the default is 'process-tree', otherwise, the default is 'none'. Note: 'system-wide' is not available on all platforms. Note: If set to 'none', CPU context switch data will still be collected unless

Short	Long	Possible Parameters	Default	Switch Description
				the --cpuctxsw switch is set to 'none'.
	--samples-per-backtrace	integer <= 32	1	The number of CPU IP samples collected for every CPU IP/backtrace sample collected. For example, if set to 4, on the fourth CPU IP sample collected, a backtrace will also be collected. Lower values increase the amount of data collected. Higher values can reduce collection overhead and reduce the number of CPU IP samples dropped. If DWARF backtraces are collected, the default is 4, otherwise the default is 1. This option is not available on Nsight Systems Embedded Platforms Edition or on non-Linux targets.

Short	Long	Possible Parameters	Default	Switch Description
	--sampling-frequency	100 < integers < 8000	1000	Specify the sampling/backtracing frequency. The minimum supported frequency is 100 Hz. The maximum supported frequency is 8000 Hz. This option is supported only on QNX, Linux for Tegra, and Windows targets.
	--sampling-period (Nsight Systems Embedded Platforms Edition)	integer	determined dynamically	The number of CPU Cycle events counted before a CPU instruction pointer (IP) sample is collected. If configured, backtraces may also be collected. The smaller the sampling period, the higher the sampling rate. Note that smaller sampling periods will increase overhead and significantly increase the size of the result file(s). Requires

Short	Long	Possible Parameters	Default	Switch Description
				`--sampling-trigger=perf` switch.
	--sampling-period (not Nsight Systems Embedded Platforms Edition)	integer	determined dynamically	The number of events counted before a CPU instruction pointer (IP) sample is collected. The event used to trigger the collection of a sample is determined dynamically. For example, on Intel based platforms, it will probably be "Reference Cycles" and on AMD platforms, "CPU Cycles". If configured, backtraces may also be collected. The smaller the sampling period, the higher the sampling rate. Note that smaller sampling periods will increase overhead and significantly increase the size of the result file(s). This option is available

Short	Long	Possible Parameters	Default	Switch Description
				only on Linux targets.
	--sampling-trigger	timer, sched, perf, cuda	timer,sched	Specify backtrace collection trigger. Multiple APIs can be selected, separated by commas only (no spaces). Available on Nsight Systems Embedded Platforms Edition targets only.
	--session-new	[a-Z][0-9,a-Z,spaces]	profile-<id>-<application>	Name the session created by the command. Name must start with an alphabetical character followed by printable or space characters. Any **`%q{ENV_VAR}`** pattern will be substituted with the value of the environment variable. Any **`%h`** pattern will be substituted with the hostname of the system. Any `%%` pattern will be substituted with `%`.

Short	Long	Possible Parameters	Default	Switch Description
-w	--show-output	true, false	true	If true, send target process' stdout and stderr streams to the console and stdout/ stderr files which are added to the QDSTRM file.
	--soc-metrics	true,false	false	Collect SOC Metrics. Available in Nsight Systems Embedded Platforms Edition only.
	--soc-metrics-frequency	integer	100000	Specify SOC Metrics sampling frequency. Minimum supported frequency is '100' (Hz). Maximum supported frequency is '1000000' (Hz). Available in Nsight Systems Embedded Platforms Edition only.
	--soc-metrics-set	see description	see description	Specify metric set for SOC Metrics sampling. The option argument must be one of indices or aliases reported by **`--soc-`**

Short	Long	Possible Parameters	Default	Switch Description
				`metrics-set=help` switch. Default is the first supported set. Available in Nsight Systems Embedded Platforms Edition only.
	--start-frame-index	1 <= integer		Start the recording session when the frame index reaches the frame number preceding the start frame index. Note when it is selected cannot include any other start options. If not specified, the default is disabled.
	--stats	true, false	false	Generate summary statistics after the collection. WARNING: When set to true, an SQLite database will be created after the collection. If the collection captures a large amount of data, creating the database file may take several minutes to complete.

Short	Long	Possible Parameters	Default	Switch Description
-x	--stop-on-exit	true, false	true	If true, stop collecting automatically when the launched process has exited or when the duration expires - whichever occurs first. If false, duration must be set and the collection stops only when the duration expires. Nsight Systems does not officially support runs longer than 5 minutes.
-t	--trace	cuda, nvtx, cublas, cublas-verbose, cusparse, cusparse-verbose, cudnn, opengl, opengl-annotations, openacc, openmp, osrt, mpi, nvvideo, vulkan, vulkan-annotations, dx11, dx11-annotations, dx12, dx12-annotations, oshmem, ucx, wddm, nvmedia, none	cuda, opengl, nvtx, osrt	Select the API(s) to be traced. The osrt switch controls the OS runtime libraries tracing. Multiple APIs can be selected, separated by commas only (no spaces). Since OpenACC, cuDNN and cuBLAS APIs are tightly linked with CUDA, selecting one of those APIs will automatically enable CUDA

Short	Long	Possible Parameters	Default	Switch Description
				tracing. Reflex SDK latency markers will be automatically collected when DX or vulkan API trace is enabled. See information on --mpi-impl option below if mpi is selected. If '<api>-annotations' is selected, the corresponding API will also be traced. If the none option is selected, no APIs are traced and no other API can be selected. Note: cublas, cudnn, nvvideo, opengl, and vulkan are not available on IBM Power target.
	--trace-fork-before-exec	true, false	false	If true, trace any child process after fork and before they call one of the exec functions. Beware, tracing in this interval relies on undefined behavior and might cause your application

Short	Long	Possible Parameters	Default	Switch Description
				to crash or deadlock. Note: This option is only available on Linux target platforms.
	--vsync	true, false	false	Collect vsync events. If collection of vsync events is enabled, display/ display_scanline ftrace events will also be captured. Available in Nsight Systems Embedded Platforms Edition only.
	--vulkan-gpu-workload	true, false, individual, batch, none	individual	If individual or true, trace each Vulkan workload's GPU activity individually. If batch, trace Vulkan workloads' GPU activity in vkQueueSubmit call batches. If none or false, do not trace Vulkan workloads' GPU activity. Note that this switch is applicable only when --trace=vulkan is specified. This option is not

Short	Long	Possible Parameters	Default	Switch Description
				supported on QNX.
	--wait	primary,all	all	If primary, the CLI will wait on the application process termination. If all, the CLI will additionally wait on re-parented processes created by the application.
	--wddm-additional-events	true, false	true	If true, collect additional range of ETW events, including context status, allocations, sync wait and signal events, etc. Note that this switch is applicable only when --trace=wddm is specified. This option is only supported on Windows targets.
	--xhv-trace	< filepath pct.json >	none	Collect hypervisor trace. Available in Nsight Systems Embedded Platforms Edition only.
	--xhv-trace-events	all, none, core, sched, irq, trap	all	Available in Nsight Systems Embedded

Short	Long	Possible Parameters	Default	Switch Description
				Platforms Edition only.

1.3.6. CLI Sessions Command Switch Subcommands

After choosing the **sessions** command switch, the following subcommands are available. Usage:

```
nsys [global-options] sessions [subcommand]
```

Subcommand	Description
list	List all active sessions including ID, name, and state information

1.3.6.1. CLI Sessions List Command Switch Options

After choosing the **sessions list** command switch, the following options are available. Usage:

```
nsys [global-options] sessions list [options]
```

Short	Long	Possible Parameters	Default	Switch Description
	--help	<tag>	none	Print the help message. The option can take one optional argument that will be used as a tag. If a tag is provided, only options relevant to the tag will be printed.
-p	--show-header	true, false	true	Controls whether a header should appear in the output.

1.3.7. CLI Shutdown Command Switch Options

After choosing the **shutdown** command switch, the following options are available. Usage:

```
nsys [global-options] shutdown [options]
```

Short	Long	Possible Parameters	Default	Switch Description
	--help	<tag>	none	Print the help message. The option can take one optional argument that will be used as a tag. If a tag is provided, only options relevant to the tag will be printed.
	--kill	On Linux: one, sigkill, sigterm, signal number On Windows: true, false	On Linux: sigterm On Windows: true	Send signal to the target application's process group when shutting down session.
	--session	session identifier	none	Shutdown the indicated session. The option argument must represent a valid session name or ID as reported by **`nsys sessions list`**. Any **`%q{ENV_VAR}`** pattern will be substituted with the value of the environment variable. Any **`%h`** pattern will be substituted with the hostname of the system. Any `%%` pattern will be substituted with `%`.

1.3.8. CLI Start Command Switch Options

After choosing the **start** command switch, the following options are available. Usage:

```
nsys [global-options] start [options]
```

Short	Long	Possible Parameters	Default	Switch Description
	--accelerator-trace	none,nvmedia	none	Collect other accelerators workload trace from the hardware engine units. Only available on Nsight Systems Embedded Platforms Edition.
-b	--backtrace	auto,fp,lbr,dwarf,none		Select the backtrace method to use while sampling. The option 'lbr' uses Intel(c) Corporation's Last Branch Record registers, available only with Intel(c) CPUs codenamed Haswell and later. The option 'fp' is frame pointer and assumes that frame pointers were enabled during compilation. The option 'dwarf' uses DWARF's CFI (Call Frame Information).

Short	Long	Possible Parameters	Default	Switch Description
				Setting the value to 'none' can reduce collection overhead.
-c	--capture-range	none, cudaProfilerApi, hotkey, nvtx	none	When --capture-range is used, profiling will start only when appropriate start API or hotkey is invoked. If --capture-range is set to none, start/stop API calls and hotkeys will be ignored. Note: hotkey works for graphic applications only. CUDA or NVTX tracing must be enabled on the target application for '-c cudaProfilerApi' or '-c nvtx' to work.
	--capture-range-end	none, stop, stop-shutdown, repeat[:N], repeat-shutdown:N	stop-shutdown	Specify the desired behavior when a capture range ends. Applicable only when used along with --capture-range option. If **none**, capture range end will

Short	Long	Possible Parameters	Default	Switch Description
				be ignored. If **`stop`**, collection will stop at capture range end. Any subsequent capture ranges will be ignored. Target app will continue running. If **`stop-shutdown`**, collection will stop at capture range end and session will be shutdown. If **`repeat[:N]`**, collection will stop at capture range end and subsequent capture ranges will trigger more collections. Use the optional **`:N`** to specify max number of capture ranges to be honored. Any subsequent capture ranges will be ignored once N capture ranges are collected. If **`repeat-shutdown:N`**, same behavior as **`repeat:N`** but session will be shutdown after N ranges. For **`stop-`**

Short	Long	Possible Parameters	Default	Switch Description
				shutdown and **repeat-shutdown:N**, as always use --kill option to specify whether target app should be terminated when shutting down session.
	--cpu-core-events (not Nsight Systems Embedded Platforms Edition)	'help' or the end users selected events in the format 'x,y'	'2' i.e. Instructions Retired	Select the CPU Core events to sample. Use the **--cpu-core-events=help** switch to see the full list of events and the number of events that can be collected simultaneously. Multiple values can be selected, separated by commas only (no spaces). Use the --event-sample switch to enable.
	--cpuctxsw	process-tree, system-wide, none	process-tree	Trace OS thread scheduling activity. Select 'none' to disable tracing CPU context switches. Depending on the platform, some values may require admin or root privileges. Note: if the --

Short	Long	Possible Parameters	Default	Switch Description
				sample switch is set to a value other than 'none', the --cpuctxsw setting is hardcoded to the same value as the --sample switch. If --sample=none and a target application is launched, the default is 'process-tree', otherwise the default is 'none'. Requires **`--sampling-trigger=perf`** switch in Nsight Systems Embedded Platforms Edition.
	--el1-sampling	true, false	false	Enable EL1 sampling. Available in Nsight Systems Embedded Platforms Edition only.
	--el1-sampling-config	< filepath config.json >	none	EL1 sampling config. Available in Nsight Systems Embedded Platforms Edition only.
	--etw-provider	"<name>,<guid>", or path to JSON file	none	Add custom ETW trace provider(s). If you want to specify more

Short	Long	Possible Parameters	Default	Switch Description
				attributes than Name and GUID, provide a JSON configuration file as as outlined below. This switch can be used multiple times to add multiple providers. Note: Only available for Windows targets.
	--event-sample	system-wide, none	none	Use the --cpu-core-events=help and the --os-events=help switches to see the full list of events. If event sampling is enabled and no events are selected, the CPU Core event 'Instructions Retired' is selected by default. Not available in Nsight Systems Embedded Platforms Edition.
	--event-sampling-frequency	Integers from 1 to 20 Hz	3	The sampling frequency used to collect event counts. Minimum event sampling frequency is 1

Short	Long	Possible Parameters	Default	Switch Description
				Hz. Maximum event sampling frequency is 20 Hz. Not available in Nsight Systems Embedded Platforms Edition.
	--export	arrow, hdf, json, sqlite, text, none	none	Create additional output file(s) based on the data collected. This option can be given more than once. WARNING: If the collection captures a large amount of data, creating the export file may take several minutes to complete.
-f	--force-overwrite	true, false	false	If true, overwrite all existing result files with same output filename (.qdstrm, .nsys-rep, .arrows, .hdf, .json, .sqlite, .
	--ftrace			Collect ftrace events. Argument should list events to collect as: subsystem1/event1,subsystem2/event2. Requires root. No ftrace events are collected by default. Note:

Short	Long	Possible Parameters	Default	Switch Description
				Not supported on IBM Power targets.
	--ftrace-keep-user-config	true, false	false	Skip initial ftrace setup and collect already configured events. Default resets the ftrace configuration.
	--gpu-metrics-device	GPU ID, help, all, none	none	Collect GPU Metrics from specified devices. Determine GPU IDs by using **`--gpu-metrics-device=help`** switch.
	--gpu-metrics-frequency	integer	10000	Specify GPU Metrics sampling frequency. Minimum supported frequency is 10 (Hz). Maximum supported frequency is 200000(Hz).
	--gpu-metrics-set	index	first	Specify metric set for GPU Metrics sampling. The argument must be one of indices reported by **`--gpu-metrics-set=help`** switch. Default is the first metric set

Short	Long	Possible Parameters	Default	Switch Description
				that supports selected GPU.
	--gpuctxsw	true,false	false	Trace GPU context switches. Note that this requires driver r435.17 or later and root permission. Not supported on IBM Power targets.
	--help	<tag>	none	Print the help message. The option can take one optional argument that will be used as a tag. If a tag is provided, only options relevant to the tag will be printed.
	--isr	true, false	false	Trace Interrupt Service Routines (ISRs) and Deferred Procedure Calls (DPCs). Requires administrative privileges. Available only on Windows devices.
	--nic-metrics	true, false	false	Collect metrics from supported NIC/HCA devices
	--os-events	'help' or the end users selected	none	Select the OS events to sample. Use the --os-

Short	Long	Possible Parameters	Default	Switch Description
		events in the format 'x,y'		events=help switch to see the full list of events. Multiple values can be selected, separated by commas only (no spaces). Use the --event-sample switch to enable. Not available in Nsight Systems Embedded Platforms Edition.
-o	--output	< filename >	report#	Set report file name. Any %q{ENV_VAR} pattern in the filename will be substituted with the value of the environment variable. Any %h pattern in the filename will be substituted with the hostname of the system. Any %p pattern in the filename will be substituted with the PID of the target process or the PID of the root process if there is a process tree. Any %% pattern in the filename will

Short	Long	Possible Parameters	Default	Switch Description
				be substituted with %. Default is report#.{nsys-rep,sqlite,h5,txt,arrows,json} in the working directory.
	--process-scope	main, process-tree, system-wide	main	Select which process(es) to trace. Available in Nsight Systems Embedded Platforms Edition only. Nsight Systems Workstation Edition will always trace system-wide in this version of the tool.
	--retain-etw-files	true, false	false	Retain ETW files generated by the trace, merge and move the files to the output directory.
-s	--sample	process-tree, system-wide, none	process-tree	Select how to collect CPU IP/backtrace samples. If 'none' is selected, CPU sampling is disabled. Depending on the platform, some values may require admin or root privileges. If a target application is launched,

Short	Long	Possible Parameters	Default	Switch Description
				the default is 'process-tree', otherwise, the default is 'none'. Note: 'system-wide' is not available on all platforms. Note: If set to 'none', CPU context switch data will still be collected unless the --cpuctxsw switch is set to 'none'.
	--samples-per-backtrace	integer <= 32	1	The number of CPU IP samples collected for every CPU IP/backtrace sample collected. For example, if set to 4, on the fourth CPU IP sample collected, a backtrace will also be collected. Lower values increase the amount of data collected. Higher values can reduce collection overhead and reduce the number of CPU IP samples dropped. If DWARF backtraces are collected, the

Short	Long	Possible Parameters	Default	Switch Description
				default is 4, otherwise the default is 1. This option is not available on Nsight Systems Embedded Platforms Edition or on non-Linux targets.
	--sampling-frequency	integers between 100 and 8000	1000	Specify the sampling/ backtracing frequency. The minimum supported frequency is 100 Hz. The maximum supported frequency is 8000 Hz. This option is supported only on QNX, Linux for Tegra, and Windows targets. Requires **`--sampling-trigger=perf`** switch in Nsight Systems Embedded Platforms Edition
	--sampling-period (Nsight Systems Embedded Platforms Edition)	integer	determined dynamically	The number of CPU Cycle events counted before a CPU instruction pointer (IP) sample is collected. If

Short	Long	Possible Parameters	Default	Switch Description
				configured, backtraces may also be collected. The smaller the sampling period, the higher the sampling rate. Note that smaller sampling periods will increase overhead and significantly increase the size of the result file(s). Requires **`--sampling-trigger=perf`** switch.
	--sampling-period (not Nsight Systems Embedded Platforms Edition)	integer	determined dynamically	The number of events counted before a CPU instruction pointer (IP) sample is collected. The event used to trigger the collection of a sample is determined dynamically. For example, on Intel based platforms, it will probably be "Reference Cycles" and on AMD platforms, "CPU Cycles". If configured, backtraces

Short	Long	Possible Parameters	Default	Switch Description
				may also be collected. The smaller the sampling period, the higher the sampling rate. Note that smaller sampling periods will increase overhead and significantly increase the size of the result file(s). This option is available only on Linux targets.
	--sampling-trigger	timer, sched, perf, cuda	timer,sched	Specify backtrace collection trigger. Multiple APIs can be selected, separated by commas only (no spaces). Available on Nsight Systems Embedded Platforms Edition targets only.
	--session	session identifier	none	Start the application in the indicated session. The option argument must represent a valid session name or ID

Short	Long	Possible Parameters	Default	Switch Description
				as reported by **nsys sessions list**. Any **%q{ENV_VAR}** pattern will be substituted with the value of the environment variable. Any **%h** pattern will be substituted with the hostname of the system. Any **%%** pattern will be substituted with **%**.
	--session-new	[a-Z][0-9,a-Z,spaces]	[default]	Start the application in a new session. Name must start with an alphabetical character followed by printable or space characters. Any **%q{ENV_VAR}** pattern will be substituted with the value of the environment variable. Any **%h** pattern will be substituted with the hostname of the system. Any **%%** pattern will be substituted with **%**.

Short	Long	Possible Parameters	Default	Switch Description
	--soc-metrics	true,false	false	Collect SOC Metrics. Available in Nsight Systems Embedded Platforms Edition only.
	--soc-metrics-frequency	integer	100000	Specify SOC Metrics sampling frequency. Minimum supported frequency is '100' (Hz). Maximum supported frequency is '1000000' (Hz). Available in Nsight Systems Embedded Platforms Edition only.
	--soc-metrics-set	see description	see description	Specify metric set for SOC Metrics sampling. The option argument must be one of indices or aliases reported by **`--soc-metrics-set=help`** switch. Default is the first supported set. Available in Nsight Systems Embedded Platforms Edition only.

Short	Long	Possible Parameters	Default	Switch Description
	--stats	true, false	false	Generate summary statistics after the collection. WARNING: When set to true, an SQLite database will be created after the collection. If the collection captures a large amount of data, creating the database file may take several minutes to complete.
-x	--stop-on-exit	true, false	true	If true, stop collecting automatically when all tracked processes have exited or when **`stop`** command is issued - whichever occurs first. If false, stop only on **`stop`** command. Note: When this is true, **`stop`** command is optional. Nsight Systems does not officially support runs longer than 5 minutes.
	--vsync	true, false	false	Collect vsync events. If collection of vsync events

Short	Long	Possible Parameters	Default	Switch Description
				is enabled, display/ display_scanline ftrace events will also be captured. Available in Nsight Systems Embedded Platforms Edition only.
	--xhv-trace	< filepath pct.json >	none	Collect hypervisor trace. Available in Nsight Systems Embedded Platforms Edition only.
	--xhv-trace-events	all, none, core, sched, irq, trap	all	Available in Nsight Systems Embedded Platforms Edition only.

1.3.9. CLI Stats Command Switch Options

The **`nsys stats`** command generates a series of summary or trace reports. These reports can be output to the console, or to individual files, or piped to external processes. Reports can be rendered in a variety of different output formats, from human readable columns of text, to formats more appropriate for data exchange, such as CSV.

Reports are generated from an SQLite export of a .nsys-rep file. If a .nsys-rep file is specified, Nsight Systems will look for an accompanying SQLite file and use it. If no SQLite file exists, one will be exported and created.

Individual reports are generated by calling out to scripts that read data from the SQLite file and return their report data in CSV format. Nsight Systems ingests this data and formats it as requested, then displays the data to the console, writes it to a file, or pipes it to an external process. Adding new reports is as simple as writing a script that can read the SQLite file and generate the required CSV output. See the shipped scripts as an example. Both reports and formatters may take arguments to tweak their processing. For details on shipped scripts and formatters, see **Report Scripts** topic.

Reports are processed using a three-tuple that consists of 1) the requested report (and any arguments), 2) the presentation format (and any arguments), and 3) the output (filename, console, or external process). The first report specified uses the first format specified, and is presented via the first output specified. The second report uses the second format for the second output, and so forth. If more reports are specified than formats or outputs, the format and/or output list is expanded to match the number of provided reports by repeating the last specified element of the list (or the default, if nothing was specified).

`nsys stats` is a very powerful command and can handle complex argument structures, please see the topic below on Example Stats Command Sequences.

After choosing the **`stats`** command switch, the following options are available. Usage:

`nsys [global-options] stats [options] [input-file]`

Short	Long	Possible Parameters	Default	Switch Description
	--help	<tag>	none	Print the help message. The option can take one optional argument that will be used as a tag. If a tag is provided, only options relevant to the tag will be printed.
-f	--format	column, table, csv, tsv, json, hdoc, htable, .		Specify the output format of the corresponding report(s). The special name "." indicates the default format for the given output. The default format for console is column, while files and process outputs default to csv. This option may be used multiple times. Multiple formats may also be

Short	Long	Possible Parameters	Default	Switch Description
				specified using a comma-separated list (<name[:args...][,name[:args...]...]>). See **Report Scripts** for options available with each format.
	--force-export	true, false	false	Force a re-export of the SQLite file from the specified .nsys-rep file, even if an SQLite file already exists.
	--force-overwrite	true, false	false	Overwrite any existing report file(s).
	--help-formats	<format_name>, ALL, [none]	none	With no argument, give a summary of the available output formats. If a format name is given, a more detailed explanation of that format is displayed. If **`ALL`** is given, a more detailed explanation of all available formats is displayed.
	--help-reports	<report_name>, ALL, [none]	none	With no argument, list a summary of the available summary and trace reports. If

Short	Long	Possible Parameters	Default	Switch Description
				a report name is given, a more detailed explanation of the report is displayed. If **ALL** is given, a more detailed explanation of all available reports is displayed.
-o	--output	-, @<command>, <basename>, .	-	Specify the output mechanism for the corresponding rule(s). There are three output mechanisms: print to console, output to file, or output to command. This option may be used multiple times. Multiple outputs may also be specified using a comma-separated list. If the given output name is "-", the rule will be displayed on the console. If the output name starts with "@", the output designates a command to run. The command will be executed

Short	Long	Possible Parameters	Default	Switch Description
				and the rule output will be piped into the command. Any other output is assumed to be the base path and name for a file. If a file basename is given, the filename used will be: <basename>_<report&args>.<ou The default base (including path) is the name of the SQLite file (as derived from the input file or --sqlite option), minus the extension. The output "." can be used to indicate the rule should be output to a file, and the default basename should be used. To write one or more rules to files using the default basename, use the option: "--output .". If the output starts with "@", the rule is output to the given command. The command is run, and the

Short	Long	Possible Parameters	Default	Switch Description
				output of the rule is piped to the command's stdin (standard-input). The command's stdout and stderr remain attached to the console, so any output will be displayed directly to the console. Be aware there are some limitations in how the command string is parsed. No shell expansions (including *, ?, [], and ~) are supported. The command cannot be piped to another command, nor redirected to a file using shell syntax. The command and command arguments are split on whitespace, and no quotes (within the command syntax) are supported. For commands that require complex command line syntax, it is

Short	Long	Possible Parameters	Default	Switch Description
				suggested that the command be put into a shell script file, and the script designated as the output command.
-q	--quiet			Do not display verbose messages, only display errors.
-r	--report	See **Report Scripts**		Specify the report(s) to generate, including any arguments. This option may be used multiple times. Multiple reports may also be specified using a comma-separated list (<name[:args...][,name[:args...]...]>). If no reports are specified, the following will be used as the default report set: nvtxsum, osrtsum, cudaapisum, gpukernsum, gpumemtimesum, gpumemsizesum, openmpevtsum, khrdebugsum, khrdebuggpusum, vulkanmarkerssum, vulkangpumarkersum, dx11pixsum, dx12gpumarkersum,

Short	Long	Possible Parameters	Default	Switch Description
				dx12pixsum, wddmqueuesdetails, unifiedmemory, unifiedmemorytotals, umcpupagefaults, openaccsum. See **Report Scripts** section for details about existing built-in scripts and how to make your own.
	--report-dir	<path>		Add a directory to the path used to find report scripts. This is usually only needed if you have one or more directories with personal scripts. This option may be used multiple times. Each use adds a new directory to the end of the path. A search path can also be defined using the environment variable "NSYS_STATS_REPORT_PATH". Directories added this way will be added after the application flags. The last two entries in the path will always be the current working

Short	Long	Possible Parameters	Default	Switch Description
				directory, followed by the directory containing the shipped **nsys** reports.
	--sqlite	<file.sqlite>		Specify the SQLite export filename. If this file exists, it will be used. If this file doesn't exist (or if --force-export was given) this file will be created from the specified .nsys-rep file before report processing. This option cannot be used if the specified input file is also an SQLite file.
	--timeunit	nsec, nanoseconds, usec, microseconds, msec, milliseconds, seconds	nanoseconds	Set basic unit of time for all rules. The argument of the switch is matched by using the longest prefix matching. Meaning that it is not necessary to write a whole word as the switch argument. It is similar to passing a ":time=<unit>" argument to

Short	Long	Possible Parameters	Default	Switch Description
				every formatter, although the formatter uses more strict naming conventions. See "nsys analyze --help-formats column" for more detailed information on unit conversion.

1.3.10. CLI Status Command Switch Options

The **`nsys status`** command returns the current state of the CLI. After choosing the **`status`** command switch, the following options are available. Usage:

```
nsys [global-options] status [options]
```

Short	Long	Possible Parameters	Default	Switch Description
-e	--environment			Returns information about the system regarding suitability of the profiling environment.
	--help	<tag>	none	Print the help message. The option can take one optional argument that will be used as a tag. If a tag is provided, only options relevant to the tag will be printed.
	--session	session identifier	none	Print the status of the indicated session. The option

Short	Long	Possible Parameters	Default	Switch Description
				argument must represent a valid session name or ID as reported by **nsyssessions list**. Any **%q{ENV_VAR}** pattern will be substituted with the value of the environment variable. Any **%h** pattern will be substituted with the hostname of the system. Any **%%** pattern will be substituted with **%**.

1.3.11. CLI Stop Command Switch Options

After choosing the **stop** command switch, the following options are available. Usage:

```
nsys [global-options] stop [options]
```

Short	Long	Possible Parameters	Default	Switch Description
	--help	<tag>	none	Print the help message. The option can take one optional argument that will be used as a tag. If a tag is provided, only options relevant to the tag will be printed.
	--session	session identifier	none	Stop the indicated session. The option

Short	Long	Possible Parameters	Default	Switch Description
				argument must represent a valid session name or ID as reported by **nsys sessions list**. Any **%q{ENV_VAR}** pattern will be substituted with the value of the environment variable. Any **%h** pattern will be substituted with the hostname of the system. Any **%%** pattern will be substituted with **%**.

1.4. Example Single Command Lines

Version Information

```
nsys -v
```

Effect: Prints tool version information to the screen.

Run with elevated privilege

```
sudo nsys profile <app>
```

Effect: Nsight Systems CLI (and target application) will run with elevated privilege. This is necessary for some features, such as FTrace or system-wide CPU sampling. If you don't want the target application to be elevated, use `--run-as` option.

Default analysis run

```
nsys profile <application>
    [application-arguments]
```

Effect: Launch the application using the given arguments. Start collecting immediately and end collection when the application stops. Trace CUDA, OpenGL, NVTX, and OS runtime libraries APIs. Collect CPU sampling information and thread scheduling information. With Nsight Systems Embedded Platforms Edition this will only analysis the single process. With Nsight Systems Workstation Edition this will trace the process tree. Generate the report#.nsys-rep file in the default location, incrementing the report number if needed to avoid overwriting any existing output files.

Limited trace only run

```
nsys profile --trace=cuda,nvtx -d 20
    --sample=none --cpuctxsw=none -o my_test <application>
    [application-arguments]
```

Effect: Launch the application using the given arguments. Start collecting immediately and end collection after 20 seconds or when the application ends. Trace CUDA and NVTX APIs. Do not collect CPU sampling information or thread scheduling information. Profile any child processes. Generate the output file as my_test.nsys-rep in the current working directory.

Delayed start run

```
nsys profile -e TEST_ONLY=0 -y 20
    <application> [application-arguments]
```

Effect: Set environment variable TEST_ONLY=0. Launch the application using the given arguments. Start collecting after 20 seconds and end collection at application exit. Trace CUDA, OpenGL, NVTX, and OS runtime libraries APIs. Collect CPU sampling and thread schedule information. Profile any child processes. Generate the report#.nsys-rep file in the default location, incrementing if needed to avoid overwriting any existing output files.

Collect ftrace events

```
nsys profile --ftrace=drm/drm_vblank_event
    -d 20
```

Effect: Collect ftrace **`drm_vblank_event`** events for 20 seconds. Generate the report#.nsys-rep file in the current working directory. Note that ftrace event collection requires running as root. To get a list of ftrace events available from the kernel, run the following:

```
sudo cat /sys/kernel/debug/tracing/available_events
```

Run GPU metric sampling on one TU10x

```
nsys profile --gpu-metrics-device=0
 --gpu-metrics-set=tu10x-gfxt <application>
```

Effect: Launch application. Collect default options and GPU metrics for the first GPU (a TU10x), using the tu10x-gfxt metric set at the default frequency (10 kHz). Profile any child processes. Generate the report#.nsys-rep file in the default location, incrementing if needed to avoid overwriting any existing output files.

Run GPU metric sampling on all GPUs at a set frequency

```
nsys profile --gpu-metrics-device=all
 --gpu-metrics-frequency=20000 <application>
```

Effect: Launch application. Collect default options and GPU metrics for all available GPUs using the first suitable metric set for each and sampling at 20 kHz. Profile any child processes. Generate the report#.nsys-rep file in the default location, incrementing if needed to avoid overwriting any existing output files.

Collect CPU IP/backtrace and CPU context switch

```
nsys profile --sample=system-wide --duration=5
```

Effect: Collects both CPU IP/backtrace samples using the default backtrace mechanism and traces CPU context switch activity for the whole system for 5 seconds. Note that it requires root permission to run. No hardware or OS events are sampled. Post processing of this collection will take longer due to the large number of symbols to be resolved caused by system-wide sampling.

Get list of available CPU core events

```
nsys profile --cpu-core-events=help
```

Effect: Lists the CPU events that can be sampled and the maximum number of CPU events that can be sampled concurrently.

Collect system-wide CPU events and trace application

```
nsys profile --event-sample=system-wide
    --cpu-core-events='1,2' --event-sampling-frequency=5 <app> [app args]
```

Effect:Collects CPU IP/backtrace samples using the default backtrace mechanism, traces CPU context switch activity, and samples each CPU's “CPU Cycles” and “Instructions Retired” event every 200 ms for the whole system. Note that it requires root permission to run. Note that CUDA, NVTX, OpenGL, and OSRT within the app launched by Nsight Systems are traced by default while using this command. Post processing of this collection will take longer due to the large number of symbols to be resolved caused by system-wide sampling.

Collect custom ETW trace using configuration file

```
nsys profile --etw-provider=file.JSON
```

Effect: Configure custom ETW collectors using the contents of file.JSON. Collect data for 20 seconds. Generate the report#.nsys-rep file in the current working directory.

A template JSON configuration file is located at in the Nsight Systems installation directory as \target-windows-x64\etw_providers_template.json. This path will show up automatically if you call

```
nsys profile --help
```

The **level** attribute can only be set to one of the following:

- TRACE_LEVEL_CRITICAL
- TRACE_LEVEL_ERROR
- TRACE_LEVEL_WARNING
- TRACE_LEVEL_INFORMATION
- TRACE_LEVEL_VERBOSE

The **flags** attribute can only be set to one or more of the following:

- EVENT_TRACE_FLAG_ALPC
- EVENT_TRACE_FLAG_CSWITCH
- EVENT_TRACE_FLAG_DBGPRINT
- EVENT_TRACE_FLAG_DISK_FILE_IO
- EVENT_TRACE_FLAG_DISK_IO
- EVENT_TRACE_FLAG_DISK_IO_INIT
- EVENT_TRACE_FLAG_DISPATCHER
- EVENT_TRACE_FLAG_DPC

- EVENT_TRACE_FLAG_DRIVER
- EVENT_TRACE_FLAG_FILE_IO
- EVENT_TRACE_FLAG_FILE_IO_INIT
- EVENT_TRACE_FLAG_IMAGE_LOAD
- EVENT_TRACE_FLAG_INTERRUPT
- EVENT_TRACE_FLAG_JOB
- EVENT_TRACE_FLAG_MEMORY_HARD_FAULTS
- EVENT_TRACE_FLAG_MEMORY_PAGE_FAULTS
- EVENT_TRACE_FLAG_NETWORK_TCPIP
- EVENT_TRACE_FLAG_NO_SYSCONFIG
- EVENT_TRACE_FLAG_PROCESS
- EVENT_TRACE_FLAG_PROCESS_COUNTERS
- EVENT_TRACE_FLAG_PROFILE
- EVENT_TRACE_FLAG_REGISTRY
- EVENT_TRACE_FLAG_SPLIT_IO
- EVENT_TRACE_FLAG_SYSTEMCALL
- EVENT_TRACE_FLAG_THREAD
- EVENT_TRACE_FLAG_VAMAP
- EVENT_TRACE_FLAG_VIRTUAL_ALLOC

Typical case: profile a Python script that uses CUDA

```
nsys profile --trace=cuda,cudnn,cublas,osrt,nvtx
    --delay=60 python my_dnn_script.py
```

Effect: Launch a Python script and start profiling it 60 seconds after the launch, tracing CUDA, cuDNN, cuBLAS, OS runtime APIs, and NVTX as well as collecting thread schedule information.

Typical case: profile an app that uses Vulkan

```
nsys profile --trace=vulkan,osrt,nvtx
    --delay=60 ./myapp
```

Effect: Launch an app and start profiling it 60 seconds after the launch, tracing Vulkan, OS runtime APIs, and NVTX as well as collecting CPU sampling and thread schedule information.

1.5. Example Interactive CLI Command Sequences

Collect from beginning of application, end manually

```
nsys start --stop-on-exit=false
nsys launch --trace=cuda,nvtx --sample=none <application> [application-
arguments]
nsys stop
```

Effect: Create interactive CLI process and set it up to begin collecting as soon as an application is launched. Launch the application, set up to allow tracing of CUDA and NVTX as well as collection of thread schedule information. Stop only when explicitly requested. Generate the report#.nsys-rep in the default location.

Note:	If you start a collection and fail to stop the collection (or if you are allowing it to stop on exit, and the application runs for too long) your system's storage space may be filled with collected data causing significant issues for the system. Nsight Systems will collect a different amount of data/ sec depending on options, but

	in general Nsight Systems does not support runs of more than 5 minutes duration.

Run application, begin collection manually, run until process ends

```
nsys launch -w true <application> [application-arguments]
nsys start
```

Effect: Create interactive CLI and launch an application set up for default analysis. Send application output to the terminal. No data is collected until you manually start collection at area of interest. Profile until the application ends. Generate the report#.nsys-rep in the default location.

Note:	If you launch an application and that application and any descendants exit before start is called Nsight Systems will create a fully formed .nsys-rep file containing no data.

Run application, start/stop collection using cudaProfilerStart/Stop

```
nsys start -c cudaProfilerApi
nsys launch -w true <application> [application-arguments]
```

Effect: Create interactive CLI process and set it up to begin collecting as soon as a cudaProfileStart() is detected. Launch application for default analysis, sending application output to the terminal. Stop collection at next call to cudaProfilerStop, when the user calls **nsys stop**, or when the root process terminates. Generate the report#.nsys-rep in the default location.

Note:	If you call **nsys launch** before **nsys start -c cudaProfilerApi** and the code contains a large number of short duration cudaProfilerStart/Stop pairs, Nsight Systems may be unable to process them correctly, causing a fault. This will be corrected in a future version.

Note:	The Nsight Systems CLI does not support multiple calls to the cudaProfilerStart/Stop API at this time.

Run application, start/stop collection using NVTX

```
nsys start -c nvtx
nsys launch -w true -p MESSAGE@DOMAIN <application> [application-arguments]
```

Effect: Create interactive CLI process and set it up to begin collecting as soon as an NVTX range with given message in given domain (capture range) is opened. Launch application for default analysis, sending application output to the terminal. Stop collection when all capture ranges are closed, when the user calls **`nsys stop`**, or when the root process terminates. Generate the report#.nsys-rep in the default location.

Note:	The Nsight Systems CLI only triggers the profiling session for the first capture range.

NVTX capture range can be specified:

- Message@Domain: All ranges with given message in given domain are capture ranges. For example:

  ```
  nsys launch -w true -p profiler@service ./app
  ```

  This would make the profiling start when the first range with message "profiler" is opened in domain "service".

- Message@*: All ranges with given message in all domains are capture ranges. For example:

  ```
  nsys launch -w true -p profiler@* ./app
  ```

  This would make the profiling start when the first range with message "profiler" is opened in any domain.
- Message: All ranges with given message in default domain are capture ranges. For example:

  ```
  nsys launch -w true -p profiler ./app
  ```

  This would make the profiling start when the first range with message "profiler" is opened in the default domain.
- By default only messages, provided by NVTX registered strings are considered to avoid additional overhead. To enable non-registered strings check please launch your application with **NSYS_NVTX_PROFILER_REGISTER_ONLY=0** environment:

  ```
  nsys launch -w true -p profiler@service -e
   NSYS_NVTX_PROFILER_REGISTER_ONLY=0 ./app
  ```

Run application, start/stop collection multiple times

The interactive CLI supports multiple sequential collections per launch.

```
nsys launch <application> [application-arguments]
nsys start
nsys stop
nsys start
nsys stop
nsys shutdown --kill sigkill
```

Effect: Create interactive CLI and launch an application set up for default analysis. Send application output to the terminal. No data is collected until the start command is executed. Collect data from start until stop requested, generate report#.qstrm in the current working directory. Collect data from second start until the second stop request, generate report#.nsys-rep (incremented by one) in the current working directory. Shutdown the interactive CLI and send sigkill to the target application's process group.

Note:	Calling **nsys cancel** after **nsys start** will cancel the collection without generating a report.

1.6. Example Stats Command Sequences

Display default statistics

```
nsys stats report1.nsys-rep
```

Effect: Export an SQLite file named report1.sqlite from report1.nsys-rep (assuming it does not already exist). Print the default reports in column format to the console.

Note: The following two command sequences should present very similar information:

```
nsys profile --stats=true <application>
```

or

```
nsys profile <application>
nsys stats report1.nsys-rep
```

Display specific data from a report

```
nsys stats --report gputrace report1.nsys-rep
```

Effect: Export an SQLite file named report1.sqlite from report1.nsys-rep (assuming it does not already exist). Print the report generated by the **`gputrace`** script to the console in column format.

Generate multiple reports, in multiple formats, output multiple places

```
nsys stats --report gputrace --report gpukernsum --report cudaapisum
--format csv,column --output .,- report1.nsys-rep
```

Effect: Export an SQLite file named report1.sqlite from report1.nsys-rep (assuming it does not already exist). Generate three reports. The first, the **`gputrace`** report, will be output to the file report1_gputrace.csv in CSV format. The other two reports, **`gpukernsum`** and **`cudaapisum`**, will be output to the console as columns of data. Although three reports were given, only two formats and outputs are given. To reconcile this, both the list of formats and outputs is expanded to match the list of reports by repeating the last element.

Submit report data to a command

```
nsys stats --report cudaapisum --format table \ --output @"grep -E
(-|Name|cudaFree" test.sqlite
```

Effect: Open test.sqlite and run the **`cudaapisum`** script on that file. Generate table data and feed that into the command **`grep -E (-|Name|cudaFree)`**. The grep command will filter out everything but the header, formatting, and the **`cudaFree`** data, and display the results to the console.

Note: When the output name starts with @, it is defined as a command. The command is run, and the output of the report is piped to the command's stdin (standard-input). The command's stdout and stderr remain attached to the console, so any output will be displayed directly to the console.

Be aware there are some limitations in how the command string is parsed. No shell expansions (including *, ?, [], and ~) are supported. The command cannot be piped to another command, nor redirected to a file using shell syntax. The command and command arguments are split on whitespace, and no quotes (within the command syntax) are supported. For commands that require complex command line syntax, it is suggested that the command be put into a shell script file, and the script designated as the output command

1.7. Example Output from --stats Option

The **`nsys stats`** command can be used post analysis to generate specific or personalized reports. For a default fixed set of summary statistics to be automatically generated, you can use the --stats option with the **`nsys profile`** or **`nsys start`** command to generate a fixed set of useful summary statistics.

If your run traces CUDA, these include CUDA API, Kernel, and Memory Operation statistics:

```
Generating cuda API Statistics...
cuda API Statistics

Time(%)     Time (ns)     Calls       Avg (ns)        Min (ns)      Max (ns)      Name
----------  ------------  ----------  --------------  ------------  ------------  ------------------------------
73.0        1858829425    404         4601062.9       131864        18705795      cudaMemcpy
11.3        287212369     1           287212369.0     287212369     287212369     cudaMalloc3DArray
4.3         108862768     2215        49148.0         3478          15493937      cudaGraphicsMapResources
3.3         84097966      202         416326.6        258148        2046180       cudaMalloc
3.0         75687195      201         376553.2        167486        1559709       cudaFree
2.1         54669996      2215        24681.7         3261          17194720      cudaGraphicsUnmapResources
1.5         37697367      4221        8930.9          5532          71517         cudaLaunch
1.4         36258561      202         179497.8        5441          737046        cudaMemcpyToSymbol
0.1         1961207       5           392241.4        350245        490291        cudaGraphicsGLRegisterBuffer
0.0         661494        4221        156.7           94            4855          cudaConfigureCall
0.0         469750        1           469750.0        469750        469750        cudaMemcpy3D
0.0         6513          1           6513.0          6513          6513          cudaBindTextureToArray



Generating cuda Kernel and Memory Operation Statistics...
cuda Kernel Statistics

Time(%)     Time (ns)     Instances   Avg (ns)        Min (ns)      Max (ns)      Name
----------  ------------  ----------  --------------  ------------  ------------  ------------------------------
38.2        20957543      1206        17377.7         9152          42272         DeviceRadixSortDownsweepKernel
36.3        19951318      1206        16543.4         15808         20961         RadixSortScanBinsKernel
13.4        7381869       1206        6121.0          3936          11776         DeviceRadixSortUpsweepKernel
12.0        6605490       603         10954.4         1920          25536         _kernel_agent

cuda Memory Operation Statistics (time)

Time(%)     Time (ns)     Operations  Avg (ns)        Min (ns)      Max (ns)      Name
----------  ------------  ----------  --------------  ------------  ------------  ------------------------------
71.9        1080910       606         1783.7          832           91361         [CUDA memcpy HtoD]
28.1        421799        1           421799.0        421799        421799        [CUDA memcpy HtoA]

cuda Memory Operation Statistics (bytes)

Total Bytes (KB)  Operations      Avg (KB)          Min (bytes)       Max (KB)          Name
----------------  --------------  ----------------  ----------------  ----------------  --------------------------
5184.0            606             8.5551            52                1024.0            [CUDA memcpy HtoD]
4096.0            1               4096.0            4194304           4096.0            [CUDA memcpy HtoA]
```

If your run traces OS runtime events or NVTX push-pop ranges:

```
Generating Operating System Runtime API Statistics...
Operating System Runtime API Statistics

Time(%)     Time (ns)     Calls       Avg (ns)        Min (ns)      Max (ns)      Name
----------  ------------  ----------  --------------  ------------  ------------  -------------------------
33.8        7780422146    388         20052634.4      1021          101325794     poll
32.5        7486252249    84          89122050.6      18165         100621271     sem_timedwait
30.4        7001017913    14          500072708.1     500054528     500094119     pthread_cond_timedwait
3.0         691921867     2879        240334.1        1000          16503430      ioctl
0.1         20746589      2156        9622.7          4703          43645         fgets
0.1         15236506      275         55405.5         1021          14452991      recvmsg
0.0         5341120       456         11713.0         1122          258129        fopen
0.0         3961960       284         13950.6         1000          91521         mmap
0.0         3660301       435         8414.5          1457          27680         fclose
0.0         1959097       246         7963.8          2252          69097         munmap
0.0         1020789       194         5261.8          2068          19845         open64
0.0         841520        489         1720.9          1000          16808         sched_yield
0.0         623388        40          15584.7         1007          50469         read
0.0         582336        158         3685.7          1289          78529         recv
0.0         279456        80          3493.2          1111          18551         writev
0.0         149645        64          2338.2          1214          10598         open
0.0         144462        5           28892.4         22780         39774         pthread_create
0.0         139762        15          9317.5          1118          77744         fread
0.0         52949         13          4073.0          1341          9112          mprotect
0.0         38777         9           4308.6          2443          10141         write
0.0         22994         4           5748.5          4763          6798          socket
0.0         21060         4           5265.0          4674          5925          sendmsg
0.0         18287         4           4571.7          2795          7277          socketpair
0.0         16881         3           5627.0          2390          7615          connect
0.0         12617         5           2523.4          1157          3926          mmap64
0.0         11368         3           3789.3          2270          5849          pipe2
0.0         11014         2           5507.0          4484          6530          pthread_cond_signal
0.0         5121          1           5121.0          5121          5121          fopen64
0.0         5118          3           1706.0          1086          2945          fcntl
0.0         4102          1           4102.0          4102          4102          shutdown
0.0         3587          1           3587.0          3587          3587          lockf
0.0         1744          1           1744.0          1744          1744          bind
0.0         1007          1           1007.0          1007          1007          fflush



Generating NVTX Push-Pop Range Statistics...
NVTX Push-Pop Range Statistics

Time(%)     Time (ns)     Instances   Avg (ns)        Min (ns)      Max (ns)      Range
----------  ------------  ----------  --------------  ------------  ------------  ---------
93.2        6856491504    201         34111898.0      6935189       285693359     frame
6.8         499693190     201         2486035.8       1874225       31362835      render
```

If your run traces graphics debug markers these include DX11 debug markers, DX12 debug markers, Vulkan debug markers or KHR debug markers:

```
Running [D:/src\output_host\Built\Bin\QuadD-Release\target-windows-x64\reports\vulkanmarkerssum.py D:\src\output_host\Built\Bin\QuadD-Release\target-windows-x64\marker_test\ue4_infiltrator_vulkan_markers.sqlite]...

Time(%)  Total Time (ns)  Instances  Average (ns)  Minimum (ns)  Maximum (ns)   StdDev                                      Range
-------  ---------------  ---------  ------------  ------------  ------------  ----------  ---------------------------------------------------------------------------
   37.2       2335018401        136    17169252.9      13692647      28504631   2729172.8  SendAllEndOfFrameUpdates
   10.7        670082802        137     4891115.3       1711561     283744644  24611148.8  BasePass
    5.0        311897629       1507      206965.9          6198       3407757    215626.1  BeginRenderingGBuffer
    3.2        198279698       1644      120608.1          3128        952634    152230.7  BeginRenderingTranslucency
    3.0        186977118        137     1364796.5       1066597       4088690    395358.6  Lights
    3.0        186626496        137     1362237.2       1064426       4084804    395189.6  DirectLighting
    1.7        104681274        137      764096.9        599535       2607777    238923.8  NonShadowedLights
    1.5         95597952        136      702926.1        535868       1944513    269677.7  PostProcessing
    1.4         85533857        137      624334.7        432949       2350711    243159.6  PrePass DDM_AllOpaque (Forced by DBuffer)
    1.3         83827427       2820       29726.0          1514        755373     43994.7  BeginRenderingPrePass
    1.3         81223414        137      592871.6        442856       1876611    186288.9  ShadowedLights
    1.3         81100377       1777       45638.9          4951       1541354    115928.7  StandardDeferredLighting
    1.3         80751508       2462       32799.2          2085       1529342     99702.1  BeginRenderingSceneColor
    1.1         70866836        276      256763.9         16485       2145669    291073.5  BeginSeparateTranslucency
    1.0         61329202      19591        3130.5          1228        319829      4991.0  M_FogSheet_Master SM_FogSheet_Plane
    0.8         52655480       1914       27510.7          2400        734665     60946.1  InjectTranslucentLightArray
    0.8         50038202      14125        3542.5          1362        281286      5669.2  M_GodRay_MASTER SM_GodRay_Plane
    0.7         43025473        137      314054.5        231792       1002868    103224.0  InjectNonShadowedTranslucentLighting
    0.6         37774169         96      393480.9        323525        550130     37746.8  UpdateGPUScene PrimitivesToUpdate and Offset = 48 0
    0.6         37313346        548       68090.0         23621        252291     39130.9  GPUParticles_SimulateAndClear
    0.6         37119090        273      135967.4         10130       4930980    389044.2  RenderVelocities
    0.6         34849906        136      256249.3        192556        597954     92451.7  DOF(Alpha=No)
    0.5         32790709        332       98767.2         13863       1703854    107206.8  VIS_ArtDemo_Screw.SpotLightStationary_7
    0.5         29069102        137      212183.2        161573        539013     56026.7  GPUParticles_PreRender
    0.4         25741368        411       62631.1         28555        342351     38492.3  ShadowProjectionOnOpaque
    0.4         24154169        136      177604.2        130608        596279     88681.5  Bloom
    0.4         23310271        548       42537.0          9120        201856     30514.7  ParticleSimulation
    0.4         23121491        411       56256.7         24857        333976     35675.2  RenderShadowProjection
    0.4         22939125        137      167438.9        137646        492316     45670.7  LightCompositionTasks_PreLighting
    0.4         22779500       6850        3325.5          1093        203231      4304.5  Environment_Wire_MASTER SK_Wires_02
    0.3         21179479        137      154594.7        107090       1582286    133950.6  ViewOcclusionTests 0
    0.3         21058892        274       76857.3         13489        447949     74050.6  VIS_ArtDemo_Screw.SM_Infil_Underground_Pipe01_439
    0.3         20158748        137      147144.1        104452       1754719    149998.6  ShadowDepths
    0.3         19368869        410       47241.1          5325        435358     62128.4  VelocityRendering
    0.3         18867829        137      137721.4        100037       1745961    146450.6  Atlas0 2048x2048
    0.3         17336627        820       21142.2         10371        119580     13048.1  InjectTranslucentVolume
    0.3         17278564        137      126120.9         83753       1551792    130703.7  IndividualQueries
    0.3         15776024        274       57576.7         21847        210442     33293.9  ParticleSimulationCommands
    0.2         15631413        274       57049.0         13915        364140     49448.6  VIS_ArtDemo_Screw.SpotLightStationary_30
    0.2         13147425        685       19193.3         10046        303482     16959.3  ShadowMapAtlases
    0.2         12826154        136       94310.0         60204       1305019    109278.5  Distortion
    0.2         12029306        821       14652.0          8142        237658     13625.1  Skinning000 Chunk=0 InStreamStart=0 OutStart=0 Vert=8021 Morph=0/0
    0.2         11313758       2740        4129.1          1377         54848      4497.1  M_CloudSheetMaster EditorPlane
    0.2         11120575        135       82374.6         61389        313120     33641.8  VIS_ArtDemo_Keyhole.SpotLightStationary_2
    0.2         10845277       1507        7196.6          3515        174162      6173.2  GBuffer
    0.2         10647885         25      425915.4        338156        962796    122138.9  UpdateGPUScene PrimitivesToUpdate and Offset = 47 0
    0.2         10420894        137       76064.9         57156        206479     20830.7  ComputeLightGrid
```

Recipes for these statistics as well as documentation on how to create your own metrics will be available in a future version of the tool.

1.8. Importing and Viewing Command Line Results Files

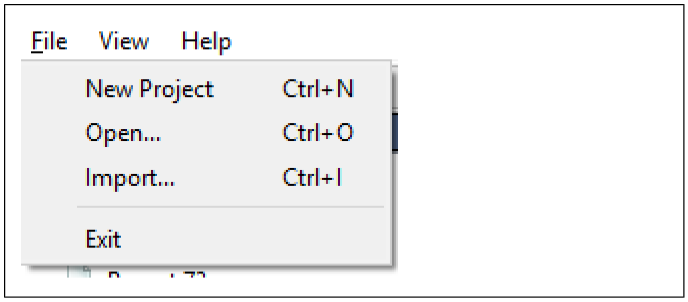
The CLI generates a .qdstrm file. The .qdstrm file is an intermediate result file, not intended for multiple imports. It needs to be processed, either by importing it into the GUI or by using the standalone QdstrmImporter to generate an optimized .nsys-rep file. Use this .nsys-rep file when re-opening the result on the same machine, opening the result on a different machine, or sharing results with teammates.

This version of Nsight Systems will attempt to automatically convert the .qdstrm file to a .nsys-rep file with the same name after the run finishes if the required libraries are available. The ability to turn off auto-conversion will be added in a later version.

Import Into the GUI

The CLI and host GUI versions must match to import a .qdstrm file successfully. The host GUI is backward compatible only with .nsys-rep files.

Copy the .qdstrm file you are interested in viewing to a system where the Nsight Systems host GUI is installed. Launch the Nsight Systems GUI. Select **File->Import...** and choose the .qdstrm file you wish to open.



The import of really large, multi-gigabyte, .qdstrm files may take up all of the memory on the host computer and lock up the system. This will be fixed in a later version.

Importing Windows ETL files

For Windows targets, ETL files captured with Xperf or the `log.cmd` command supplied with GPUView in the Windows Performance Toolkit can be imported to create reports as if they were captured with Nsight Systems's "WDDM trace" and "Custom ETW trace" features. Simply choose the .etl file from the Import dialog to convert it to a .nsys-rep file.

Create .nsys-rep Using QdstrmImporter

The CLI and QdstrmImporter versions must match to convert a .qdstrm file into a .nsys-rep file. This .nsys-rep file can then be opened in the same version or more recent versions of the GUI.

To run QdstrmImporter on the host system, find the QdstrmImporter binary in the Host-x86_64 directory in your installation. QdstrmImporter is available for all host platforms. See options below.

To run QdstrmImporter on the target system, copy the Linux Host-x86_64 directory to the target Linux system or install Nsight Systems for Linux host directly on the target. The Windows or macOS host QdstrmImporter will not work on a Linux Target. See options below.

Short	Long	Parameter	Description
-h	--help		Help message providing information about available options and their parameters.
-v	--version		Output QdstrmImporter version information
-i	--input-file	filename or path	Import .qdstrm file from this location.
-o	--output-file	filename or path	Provide a different file name or path for the resulting .nsys-

Short	Long	Parameter	Description
			rep file. Default is the same name and path as the .qdstrm file

1.9. Using the CLI to Analyze MPI Codes

1.9.1. Tracing MPI API calls

The Nsight Systems CLI has built-in API trace support for Open MPI and MPICH based MPI implementations via **`--trace=mpi`**. It traces a subset of the MPI API, including blocking and non-blocking point-to-point and collective communication as well as MPI one-sided communication, file I/O and pack operations (see MPI functions traced).

If you require more control over the list of traced APIs or if you are using a different MPI implementation, you can use the NVTX wrappers for MPI on GitHub. Choose an NVTX domain name other than "MPI", since it is filtered out by Nsight Systems when MPI tracing is not enabled. Use the NVTX-instrumented MPI wrapper library as follows:

`nsys profile -e LD_PRELOAD=${PATH_TO_YOUR_NVTX_MPI_LIB} --trace=nvtx`

1.9.2. Using the CLI to Profile Applications Launched with mpirun

The Nsight Systems CLI supports concurrent use of the **`nsys profile`** command. Each instance will create a separate report file. You cannot use multiple instances of the interactive CLI concurrently, or use the interactive CLI concurrently with **`nsys profile`** in this version.

Nsight Systems can be used to profile applications launched with **`mpirun`** or **`mpiexec`**. Since concurrent use of the CLI is supported only when using the **`nsys profile`** command, Nsight Systems cannot profile each node from the GUI or from the interactive CLI.

Profile all MPI ranks on a single node: **`nsys`** can be prefixed before **`mpirun/mpiexec`**. Only a single report file will be created.

```
nsys [nsys options] mpirun [mpirun options]
```

Profile multi-node runs: **`nsys profile`** has to be prefixed before the program to be profiled. One report file will be created for each MPI rank. This works also for single-node runs.

```
mpirun [mpirun options] nsys profile [nsys options]
```

You can use **`%q{OMPI_COMM_WORLD_RANK}`** (Open MPI), **`%q{PMI_RANK}`** (MPICH) or **`%q{SLURM_PROCID}`** (Slurm) with the **`-o`** option to appropriately name the report files.

Profile a single MPI process or a subset of MPI processes: Use a wrapper script similar to the following script (called "profile_rank0.sh").

```
#!/bin/bash

# Use $PMI_RANK for MPICH and $SLURM_PROCID with srun.
if [ $OMPI_COMM_WORLD_RANK -eq 0 ]; then
  nsys profile -e NSYS_MPI_STORE_TEAMS_PER_RANK=1 -t mpi "$@"
else
  "$@"
fi
```

The script runs nsys on rank 0 only. Add appropriate profiling options to the script and execute it with **`mpirun [mpirun options] ./profile_rank0.sh ./myapp [app options]`**.

Note:	If only a subset of MPI ranks is profiled, set the environment variable **`NSYS_MPI_STORE_TEAMS_PER_RANK=1`** to store all members of custom MPI communicators per MPI rank. Otherwise, the execution might hang or fail with an MPI error.

Avoid redundant GPU and NIC metrics collection: If multiple instances of **`nsys profile`** are executed concurrently on the same node and GPU and/or NIC metrics collection is enabled, each process will collect metrics for all available NICs and tries to collect GPU metrics for the specified devices. This can be avoided with a simple bash script similar to the following:

```
#!/bin/bash

# Use $SLURM_LOCALID with srun.
if [ $OMPI_COMM_WORLD_LOCAL_RANK -eq 0 ]; then
  nsys profile --nic-metrics=true --gpu-metrics-device=all "$@"
else
  nsys profile "$@"
fi
```

This above script will collect NIC and GPU metrics only for one rank, the node-local rank 0. Alternatively, if one rank per GPU is used, the GPU metrics devices can be specified based on the node-local rank in a wrapper script as follows:

```
#!/bin/bash

# Use $SLURM_LOCALID with srun.
nsys profile -e CUDA_VISIBLE_DEVICES=${OMPI_COMM_WORLD_LOCAL_RANK} \
  --gpu-metrics-device=${OMPI_COMM_WORLD_LOCAL_RANK} "$@"
```

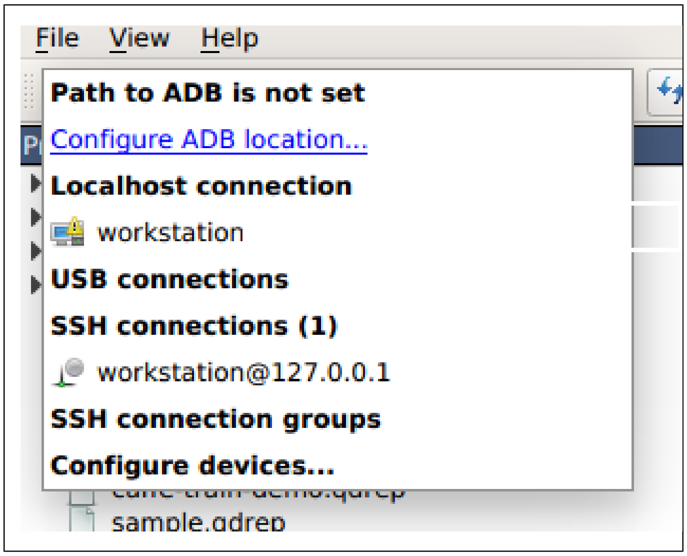
Chapter 2. PROFILING FROM THE GUI

2.1. Profiling Linux Targets from the GUI

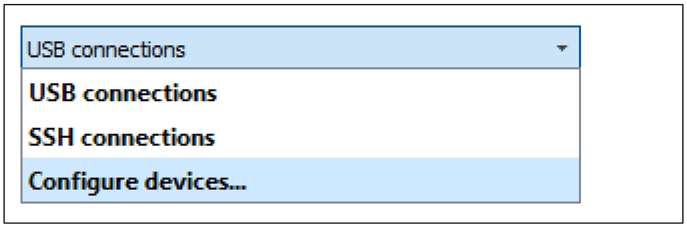
2.1.1. Connecting to the Target Device

Nsight Systems provides a simple interface to profile on localhost or manage multiple connections to Linux or Windows based devices via SSH. The network connections manager can be launched through the device selection dropdown:

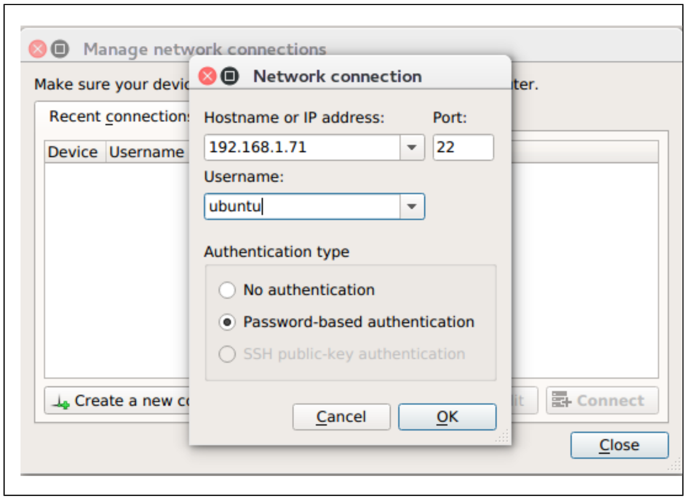
On x86_64:



On Tegra:



The dialog has simple controls that allow adding, removing, and modifying connections:



Security notice: SSH is only used to establish the initial connection to a target device, perform checks, and upload necessary files. The actual profiling commands and data are transferred through a raw, unencrypted socket. Nsight Systems should not be used in a network setup where attacker-in-the-middle attack is possible, or where untrusted parties may have network access to the target device.

While connecting to the target device, you will be prompted to input the user's password. Please note that if you choose to remember the password, it will be stored in plain text in the configuration file on the host. Stored passwords are bound to the public key fingerprint of the remote device.

The **No authentication** option is useful for devices configured for passwordless login using **`root`** username. To enable such a configuration, edit the file **`/etc/ssh/sshd_config`** on the target and specify the following option:

```
PermitRootLogin yes
```

Then set empty password using **`passwd`** and restart the SSH service with **`service ssh restart`**.

Open ports: The Nsight Systems daemon requires port 22 and port 45555 to be open for listening. You can confirm that these ports are open with the following command:

```
sudo firewall-cmd --list-ports --permanent
sudo firewall-cmd --reload
```

To open a port use the following command, skip **`--permanent`** option to open only for this session:

```
sudo firewall-cmd --permanent --add-port 45555/tcp
sudo firewall-cmd --reload
```

Likewise, if you are running on a cloud system, you must open port 22 and port 45555 for ingress.

Kernel Version Number - To check for the version number of the kernel support of Nsight Systems on a target device, run the following command on the remote device:

```
cat /proc/quadd/version
```

Minimal supported version is 1.82.

Additionally, presence of Netcat command (**nc**) is required on the target device. For example, on Ubuntu this package can be installed using the following command:

```
sudo apt-get install netcat-openbsd
```

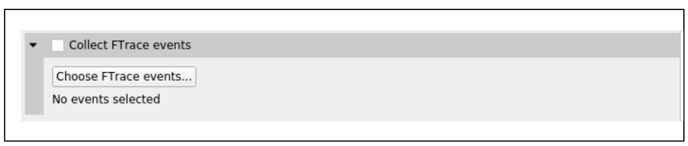
2.1.2. System-Wide Profiling Options

2.1.2.1. Linux x86_64

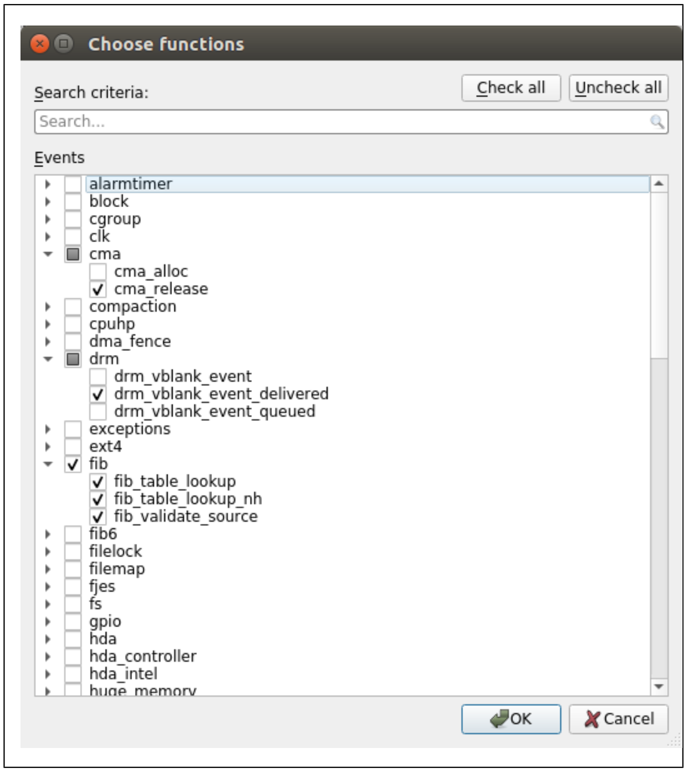
System-wide profiling is available on x86 for Linux targets only\ when run with root privileges.

Ftrace Events Collection

Select Ftrace events



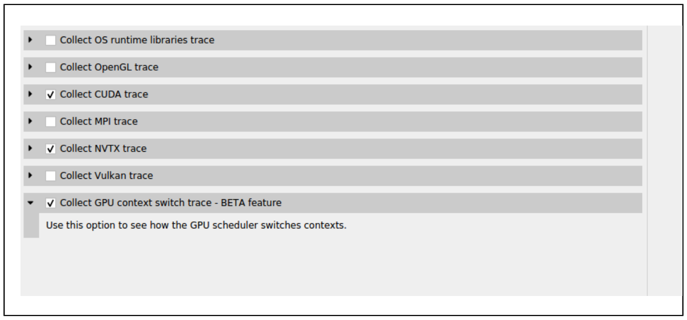
Choose which events you would like to collect.



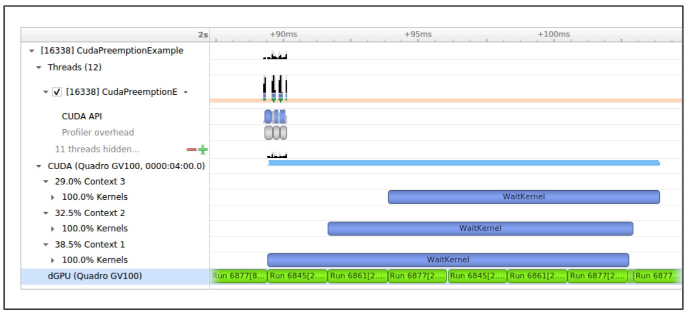
Note:	Ftrace profiling option will not be displayed in the GUI unless you are running with sudo. Also be aware that enabling too many options can cause significant setup/teardown overhead.

GPU Context Switch Trace

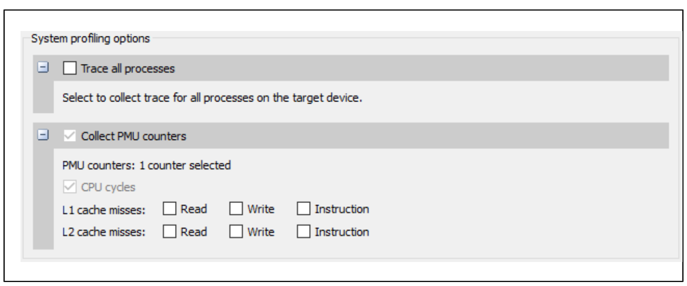
Tracing of context switching on the GPU is enabled with driver r435.17 or higher.



Here is a screenshot showing three CUDA kernels running simultaneously in three different CUDA contexts on a single GPU.



2.1.2.2. Linux for Tegra



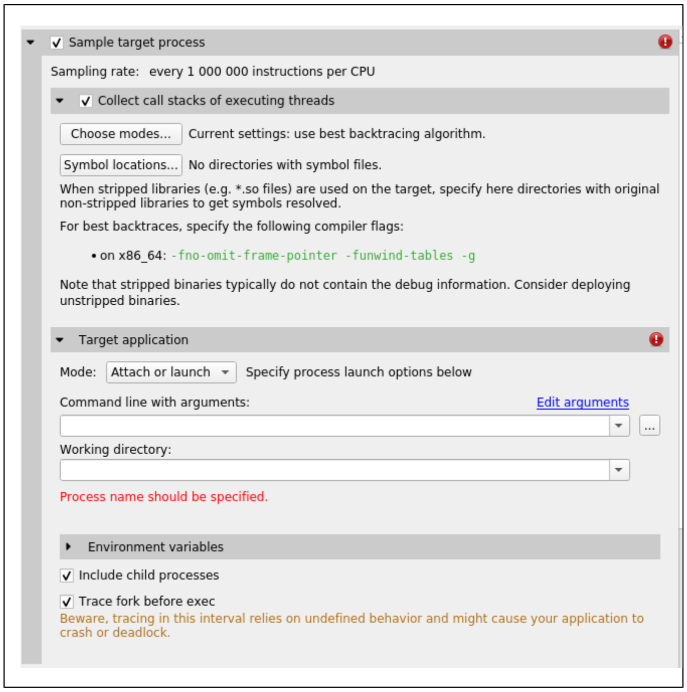
Trace all processes – On compatible devices (with kernel module support version 1.107 or higher), this enables trace of all processes and threads in the system. Scheduler events from all tasks will be recorded.

Collect PMU counters – This allows you to choose which PMU (Performance Monitoring Unit) counters Nsight Systems will sample. Enable specific counters when interested in correlating cache misses to functions in your application.

2.1.3. Target Sampling Options

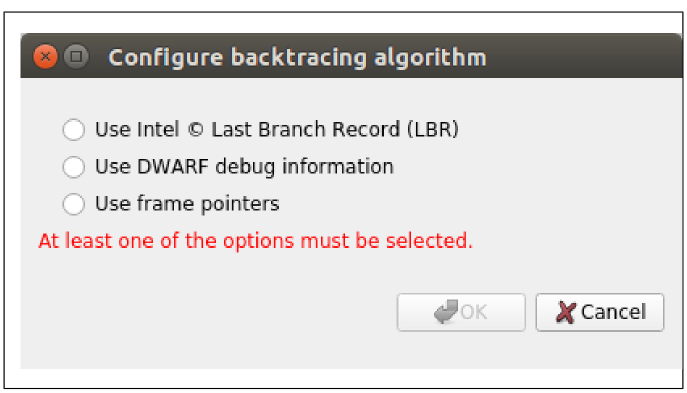
Target sampling behavior is somewhat different for Nsight Systems Workstation Edition and Nsight Systems Embedded Platforms Edition.

Target Sampling Options for Workstation



Three different backtrace collections options are available when sampling CPU instruction pointers. Backtraces can be generated using Intel (c) Last Branch Record (LBR) registers. LBR backtraces generate minimal overhead but the backtraces have limited depth. Backtraces can also be generated using DWARF debug data. DWARF backtraces incur more overhead than LBR backtraces but have much better depth. Finally, backtraces can be generated using frame pointers. Frame pointer backtraces incur medium overhead and have good depth but only resolve frames in the portions of the application and its libraries (including 3rd party libraries) that were compiled with frame pointers enabled. Normally, frame pointers are disabled by default during compilation.

By default, Nsight Systems will use Intel(c) LBRs if available and fall back to using dwarf unwind if they are not. **Choose modes...** will allow you to override the default.



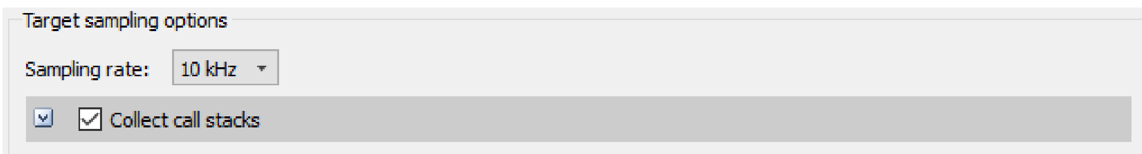
The **Include child processes** switch controls whether API tracing is only for the launched process, or for all existing and new child processes of the launched process. If you are running your application through a script, for example a bash script, you need to set this checkbox.

The **Include child processes** switch does not control sampling in this version of Nsight Systems. The full process tree will be sampled regardless of this setting. This will be fixed in a future version of the product.

Nsight Systems can sample one process tree. Sampling here means interrupting each processor after a certain number of events and collecting an instruction pointer (IP)/backtrace sample if the processor is executing the profilee.

When sampling the CPU on a workstation target, Nsight Systems traces thread context switches and infers thread state as either Running or Blocked. Note that Blocked in the timeline indicates the thread may be Blocked (Interruptible) or Blocked (Uninterruptible). Blocked (Uninterruptible) often occurs when a thread has transitioned into the kernel and cannot be interrupted by a signal. Sampling can be enhanced with OS runtime libraries tracing; see OS Runtime Libraries Trace for more information.

Target Sampling Options for Embedded Linux



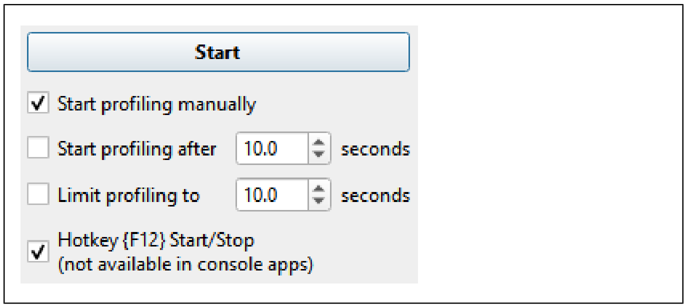
Currently Nsight Systems can only sample one process. Sampling here means that the profilee will be stopped periodically, and backtraces of active threads will be recorded.

Most applications use stripped libraries. In this case, many symbols may stay unresolved. If unstripped libraries exist, paths to them can be specified using the **Symbol locations...** button. Symbol resolution happens on host, and therefore does not affect performance of profiling on the target.

Additionally, debug versions of ELF files may be picked up from the target system. Refer to Debug Versions of ELF Files for more information.

2.1.4. Hotkey Trace Start/Stop

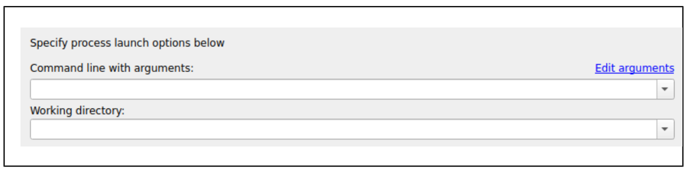
Nsight Systems Workstation Edition can use hotkeys to control profiling. Press the hotkey to start and/or stop a trace session from within the target application's graphic window. This is useful when tracing games and graphic applications that use fullscreen display. In these scenarios switching to Nsight Systems' UI would unnecessarily introduce the window manager's footprint into the trace. To enable the use of Hotkey check the Hotkey checkbox in the project settings page:



The default hotkey is F12.

2.1.5. Launching Processes

Nsight Systems can launch new processes for profiling on target devices. Profiler ensures that all environment variables are set correctly to successfully collect trace information



The **Edit arguments...** link will open an editor window, where every command line argument is edited on a separate line. This is convenient when arguments contain spaces or quotes.

2.2. Profiling Windows Targets from the GUI

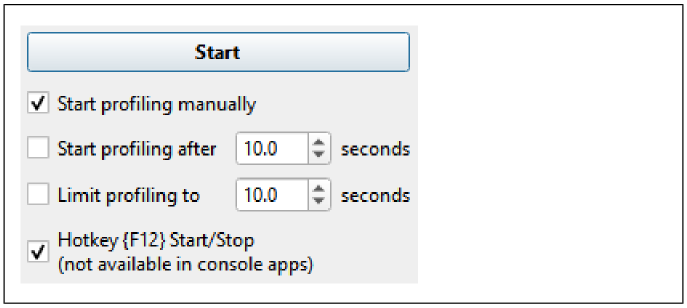
Profiling on Windows devices is similar to the profiling on Linux devices. Please refer to the Profiling Linux Targets from the GUI section for the detailed documentation and connection information. The major differences on the platforms are listed below:

Remoting to a Windows Based Machine

To perform remote profiling to a target Windows based machines, install and configure an OpenSSH Server on the target machine.

Hotkey Trace Start/Stop

Nsight Systems Workstation Edition can use hotkeys to control profiling. Press the hotkey to start and/or stop a trace session from within the target application’s graphic window. This is useful when tracing games and graphic applications that use fullscreen display. In these scenarios switching to Nsight Systems' UI would unnecessarily introduce the window manager's footprint into the trace. To enable the use of Hotkey check the Hotkey checkbox in the project settings page:



The default hotkey is F12.

Changing the Default Hotkey Binding - A different hotkey binding can be configured by setting the HotKeyIntValue configuration field in the config.ini file.

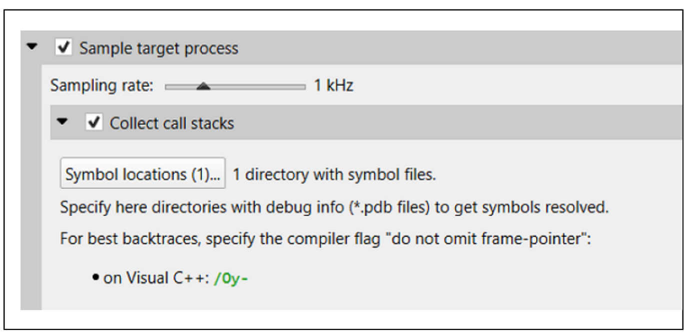
Set the decimal numeric identifier of the hotkey you would like to use for triggering start/stop from the target app graphics window. The default value is 123 which corresponds to 0x7B, or the F12 key.

Virtual key identifiers are detailed in MSDN's Virtual-Key Codes.

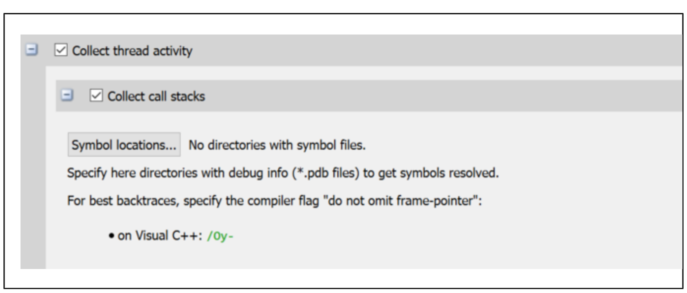
Note that you must convert the hexadecimal values detailed in this page to their decimal counterpart before using them in the file. For example, to use the F1 key as a start/stop trace hotkey, use the following settings in the config.ini file:

```
HotKeyIntValue=112
```

Target Sampling Options on Windows



Nsight Systems can sample one process tree. Sampling here means interrupting each processor periodically. The sampling rate is defined in the project settings and is either 100Hz, 1KHz (default value), 2Khz, 4KHz, or 8KHz.



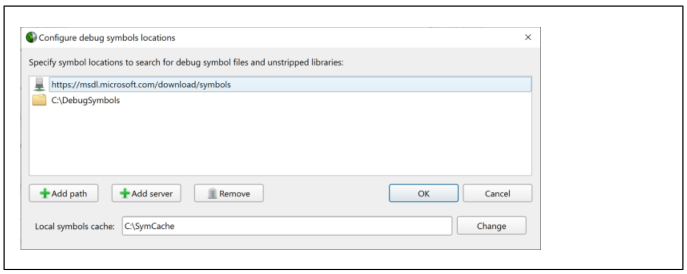
On Windows, Nsight Systems can collect thread activity of one process tree. Collecting thread activity means that each thread context switch event is logged and (optionally) a backtrace is collected at the point that the thread is scheduled back for execution. Thread states are displayed on the timeline.

If it was collected, the thread backtrace is displayed when hovering over a region where the thread execution is blocked.

Symbol Locations

Symbol resolution happens on host, and therefore does not affect performance of profiling on the target.

Press the **Symbol locations...** button to open the **Configure debug symbols location** dialog.



Use this dialog to specify:

- Paths of PDB files
- Symbols servers
- The location of the local symbol cache

To use a symbol server:

1. Install **Debugging Tools for Windows**, a part of the Windows 10 SDK.
2. Add the symbol server URL using the **Add Server** button.

   Information about Microsoft's public symbol server, which enables getting Windows operating system related debug symbols can be found here.

2.3. Profiling QNX Targets from the GUI

Profiling on QNX devices is similar to the profiling on Linux devices. Please refer to the Profiling Linux Targets from the GUI section for the detailed documentation. The major differences on the platforms are listed below:

- Backtrace sampling is not supported. Instead backtraces are collected for long OS runtime libraries calls. Please refer to the OS Runtime Libraries Trace section for the detailed documentation.
- CUDA support is limited to CUDA 9.0+

- Filesystem on QNX device might be mounted read-only. In that case Nsight Systems is not able to install target-side binaries, required to run the profiling session. Please make sure that target filesystem is writable before connecting to QNX target. For example, make sure the following command works:

```
echo XX > /xx && ls -l /xx
```

Chapter 3. EXPORT FORMATS

3.1. SQLite Schema Reference

Nsight Systems has the ability to export SQLite database files from the .nsys-rep results file. From the CLI, use **`nsys export`**. From the GUI, call **`File->Export...`**.

Note: The .nsys-rep report format is the only data format for Nsight Systems that should be considered forward compatible. The SQLite schema can and will change in the future.

The schema for a concrete database can be obtained with the sqlite3 tool built-in command **`.schema`**. The sqlite3 tool can be located in the Target or Host directory of your Nsight Systems installation.

Note: Currently tables are created lazily, and therefore not every table described in the documentation will be present in a particular database. This will change in a future version of the product. If you want a full schema of all possible tables, use **`nsys export --lazy=false`** during export phase.

Currently, a table is created for each data type in the exported database. Since usage patterns for exported data may vary greatly and no default use cases have been established, no indexes or extra constraints are created. Instead, refer to the SQLite Examples section for a list of common recipes. This may change in a future version of the product.

To check the version of your exported SQLite file, check the value of **`EXPORT_SCHEMA_VERSION`** in the **`EXPORT_META_DATA`** table. The schema version is a common three-value major/minor/micro version number. The first value, or major value, indicates the overall format of the database, and is only changed if there is a major re-write or re-factor of the entire database format. It is assumed that if the major version changes, all scripts or queries will break. The middle, or minor, version is changed anytime there is a more localized, but potentially breaking change, such as renaming an existing column, or changing the type of an existing column. The last, or micro version is changed any time there are additions, such as a new table or column, that should not introduce any breaking change when used with well-written, best-practices queries.

This is the schema as of the 2021.5 release, schema version 2.7.1.

```
CREATE TABLE StringIds (
    -- Consolidation of repetitive string values.

    id                          INTEGER   NOT NULL   PRIMARY KEY,      -- ID
 reference value.
    value                       TEXT      NOT NULL                     -- String
 value.
);
CREATE TABLE ThreadNames (
    nameId                      INTEGER   NOT NULL   REFERENCES StringIds(id),
 -- StringId of the thread name.
    priority                    INTEGER,                               --
 Priority of the thread.
    globalTid                   INTEGER                                --
 Serialized GlobalId.
);
CREATE TABLE ProcessStreams (
    globalPid                   INTEGER   NOT NULL,                    --
 Serialized GlobalId.
    filenameId                  INTEGER   NOT NULL   REFERENCES StringIds(id),
 -- StringId of the file name.
    contentId                   INTEGER   NOT NULL   REFERENCES StringIds(id) --
 StringId of the stream content.
);
CREATE TABLE TARGET_INFO_SYSTEM_ENV (
    globalVid                   INTEGER   NOT NULL,                    --
 Serialized GlobalId.
    devStateName                TEXT      NOT NULL,                    -- Device
 state name.
    name                        TEXT      NOT NULL,                    --
 Property name.
    nameEnum                    INTEGER   NOT NULL,                    --
 Property enum value.
    value                       TEXT      NOT NULL                     --
 Property value.
);
CREATE TABLE TARGET_INFO_SESSION_START_TIME (
    utcEpochNs                  INTEGER,                               -- UTC
 Epoch timestamp at start of the capture (ns).
    utcTime                     TEXT,                                  -- Start
 of the capture in UTC.
    localTime                   TEXT                                   -- Start
 of the capture in local time of target.
);
CREATE TABLE ANALYSIS_DETAILS (
    -- Details about the analysis session.

    globalVid                   INTEGER   NOT NULL,                    --
 Serialized GlobalId.
    duration                    INTEGER   NOT NULL,                    -- The
 total time span of the entire trace (ns).
    startTime                   INTEGER   NOT NULL,                    -- Trace
 start timestamp in nanoseconds.
    stopTime                    INTEGER   NOT NULL                     -- Trace
 stop timestamp in nanoseconds.
);
CREATE TABLE TARGET_INFO_GPU (
    vmId                        INTEGER   NOT NULL,                    --
 Serialized GlobalId.
    id                          INTEGER   NOT NULL,                    -- Device
 ID.
    name                        TEXT,                                  -- Device
 name.
    busLocation                 TEXT,                                  -- PCI
 bus location.
    isDiscrete                  INTEGER,                               -- True
 if discrete, false if integrated.
    l2CacheSize                 INTEGER,                               -- Size
 of L2 cache (B).
    totalMemory                 INTEGER,                               -- Total
 amount of memory on the device (B).
    memoryBandwidth             INTEGER,                               -- Amount
 of memory transferred (B).
```

3.2. SQLite Schema Event Values

Here are the set values stored in enums in the Nsight Systems SQLite schema

CUDA Event Class Values

```
0 - TRACE_PROCESS_EVENT_CUDA_RUNTIME
1 - TRACE_PROCESS_EVENT_CUDA_DRIVER
13 - TRACE_PROCESS_EVENT_CUDA_EGL_DRIVER
28 - TRACE_PROCESS_EVENT_CUDNN
29 - TRACE_PROCESS_EVENT_CUBLAS
33 - TRACE_PROCESS_EVENT_CUDNN_START
34 - TRACE_PROCESS_EVENT_CUDNN_FINISH
35 - TRACE_PROCESS_EVENT_CUBLAS_START
36 - TRACE_PROCESS_EVENT_CUBLAS_FINISH
67 - TRACE_PROCESS_EVENT_CUDABACKTRACE
77 - TRACE_PROCESS_EVENT_CUDA_GRAPH_NODE_CREATION
```

See CUPTI documentation for detailed information on collected event and data types.

NVTX Event Type Values

```
33 - NvtxCategory
34 - NvtxMark
39 - NvtxThread
59 - NvtxPushPopRange
60 - NvtxStartEndRange
75 - NvtxDomainCreate
76 - NvtxDomainDestroy
```

The difference between text and textId columns is that if an NVTX event message was passed via call to nvtxDomainRegisterString function, then the message will be available through textId field, otherwise the text field will contain the message if it was provided.

OpenGL Events

KHR event class values

```
62 - KhrDebugPushPopRange
63 - KhrDebugGpuPushPopRange
```

KHR source kind values

```
0x8249 - GL_DEBUG_SOURCE_THIRD_PARTY
0x824A - GL_DEBUG_SOURCE_APPLICATION
```

KHR type values

```
0x824C - GL_DEBUG_TYPE_ERROR
0x824D - GL_DEBUG_TYPE_DEPRECATED_BEHAVIOR
0x824E - GL_DEBUG_TYPE_UNDEFINED_BEHAVIOR
0x824F - GL_DEBUG_TYPE_PORTABILITY
0x8250 - GL_DEBUG_TYPE_PERFORMANCE
0x8251 - GL_DEBUG_TYPE_OTHER
0x8268 - GL_DEBUG_TYPE_MARKER
0x8269 - GL_DEBUG_TYPE_PUSH_GROUP
0x826A - GL_DEBUG_TYPE_POP_GROUP
```

KHR severity values

```
0x826B - GL_DEBUG_SEVERITY_NOTIFICATION
0x9146 - GL_DEBUG_SEVERITY_HIGH
0x9147 - GL_DEBUG_SEVERITY_MEDIUM
0x9148 - GL_DEBUG_SEVERITY_LOW
```

OSRT Event Class Values

OS runtime libraries can be traced to gather information about low-level userspace APIs. This traces the system call wrappers and thread synchronization interfaces exposed by the C runtime and POSIX Threads (pthread) libraries. This does not perform a complete runtime library API trace, but instead focuses on the functions that can take a long time to execute, or could potentially cause your thread be unscheduled from the CPU while waiting for an event to complete.

OSRT events may have callchains attached to them, depending on selected profiling settings. In such cases, one can use callchainId column to select relevant callchains from OSRT_CALLCHAINS table

OSRT event class values

```
27 - TRACE_PROCESS_EVENT_OS_RUNTIME
31 - TRACE_PROCESS_EVENT_OS_RUNTIME_START
32 - TRACE_PROCESS_EVENT_OS_RUNTIME_FINISH
```

DX12 Event Class Values

```
41 - TRACE_PROCESS_EVENT_DX12_API
42 - TRACE_PROCESS_EVENT_DX12_WORKLOAD
43 - TRACE_PROCESS_EVENT_DX12_START
44 - TRACE_PROCESS_EVENT_DX12_FINISH
52 - TRACE_PROCESS_EVENT_DX12_DISPLAY
59 - TRACE_PROCESS_EVENT_DX12_CREATE_OBJECT
```

PIX Event Class Values

```
65 - TRACE_PROCESS_EVENT_DX12_DEBUG_API
75 - TRACE_PROCESS_EVENT_DX11_DEBUG_API
```

Vulkan Event Class Values

```
53 - TRACE_PROCESS_EVENT_VULKAN_API
54 - TRACE_PROCESS_EVENT_VULKAN_WORKLOAD
55 - TRACE_PROCESS_EVENT_VULKAN_START
56 - TRACE_PROCESS_EVENT_VULKAN_FINISH
60 - TRACE_PROCESS_EVENT_VULKAN_CREATE_OBJECT
66 - TRACE_PROCESS_EVENT_VULKAN_DEBUG_API
```

Vulkan Flags

```
VALID_BIT = 0x00000001
CACHE_HIT_BIT = 0x00000002
BASE_PIPELINE_ACCELERATION_BIT = 0x00000004
```

SLI Event Class Values

```
62 - TRACE_PROCESS_EVENT_SLI
63 - TRACE_PROCESS_EVENT_SLI_START
64 - TRACE_PROCESS_EVENT_SLI_FINISH
```

SLI Transfer Info Values

```
0 - P2P_SKIPPED
1 - P2P_EARLY_PUSH
2 - P2P_PUSH_FAILED
3 - P2P_2WAY_OR_PULL
4 - P2P_PRESENT
5 - P2P_DX12_INIT_PUSH_ON_WRITE
```

WDDM Event Values

VIDMM operation type values

```
0 - None
101 - RestoreSegments
102 - PurgeSegments
103 - CleanupPrimary
104 - AllocatePagingBufferResources
105 - FreePagingBufferResources
106 - ReportVidMmState
107 - RunApertureCoherencyTest
108 - RunUnmapToDummyPageTest
109 - DeferredCommand
110 - SuspendMemorySegmentAccess
111 - ResumeMemorySegmentAccess
112 - EvictAndFlush
113 - CommitVirtualAddressRange
114 - UncommitVirtualAddressRange
115 - DestroyVirtualAddressAllocator
116 - PageInDevice
117 - MapContextAllocation
118 - InitPagingProcessVaSpace
200 - CloseAllocation
202 - ComplexLock
203 - PinAllocation
204 - FlushPendingGpuAccess
205 - UnpinAllocation
206 - MakeResident
207 - Evict
208 - LockInAperture
209 - InitContextAllocation
210 - ReclaimAllocation
211 - DiscardAllocation
212 - SetAllocationPriority
1000 - EvictSystemMemoryOfferList
```

Paging queue type values

```
0 - VIDMM_PAGING_QUEUE_TYPE_UMD
1 - VIDMM_PAGING_QUEUE_TYPE_Default
2 - VIDMM_PAGING_QUEUE_TYPE_Evict
3 - VIDMM_PAGING_QUEUE_TYPE_Reclaim
```

Packet type values

```
0 - DXGKETW_RENDER_COMMAND_BUFFER
1 - DXGKETW_DEFERRED_COMMAND_BUFFER
2 - DXGKETW_SYSTEM_COMMAND_BUFFER
3 - DXGKETW_MMIOFLIP_COMMAND_BUFFER
4 - DXGKETW_WAIT_COMMAND_BUFFER
5 - DXGKETW_SIGNAL_COMMAND_BUFFER
6 - DXGKETW_DEVICE_COMMAND_BUFFER
7 - DXGKETW_SOFTWARE_COMMAND_BUFFER
```

Engine type values

```
0 - DXGK_ENGINE_TYPE_OTHER
1 - DXGK_ENGINE_TYPE_3D
2 - DXGK_ENGINE_TYPE_VIDEO_DECODE
3 - DXGK_ENGINE_TYPE_VIDEO_ENCODE
4 - DXGK_ENGINE_TYPE_VIDEO_PROCESSING
5 - DXGK_ENGINE_TYPE_SCENE_ASSEMBLY
6 - DXGK_ENGINE_TYPE_COPY
7 - DXGK_ENGINE_TYPE_OVERLAY
8 - DXGK_ENGINE_TYPE_CRYPTO
```

DMA interrupt type values

```
1 = DXGK_INTERRUPT_DMA_COMPLETED
2 = DXGK_INTERRUPT_DMA_PREEMPTED
4 = DXGK_INTERRUPT_DMA_FAULTED
9 = DXGK_INTERRUPT_DMA_PAGE_FAULTED
```

Queue type values

```
0 = Queue_Packet
1 = Dma_Packet
2 = Paging_Queue_Packet
```

Driver Events

Load balance event type values

```
1 - LoadBalanceEvent_GPU
8 - LoadBalanceEvent_CPU
21 - LoadBalanceMasterEvent_GPU
22 - LoadBalanceMasterEvent_CPU
```

OpenMP Events

OpenMP event class values

```
78 - TRACE_PROCESS_EVENT_OPENMP
79 - TRACE_PROCESS_EVENT_OPENMP_START
80 - TRACE_PROCESS_EVENT_OPENMP_FINISH
```

OpenMP event kind values

```
15 - OPENMP_EVENT_KIND_TASK_CREATE
16 - OPENMP_EVENT_KIND_TASK_SCHEDULE
17 - OPENMP_EVENT_KIND_CANCEL
20 - OPENMP_EVENT_KIND_MUTEX_RELEASED
21 - OPENMP_EVENT_KIND_LOCK_INIT
22 - OPENMP_EVENT_KIND_LOCK_DESTROY
25 - OPENMP_EVENT_KIND_DISPATCH
26 - OPENMP_EVENT_KIND_FLUSH
27 - OPENMP_EVENT_KIND_THREAD
28 - OPENMP_EVENT_KIND_PARALLEL
29 - OPENMP_EVENT_KIND_SYNC_REGION_WAIT
30 - OPENMP_EVENT_KIND_SYNC_REGION
31 - OPENMP_EVENT_KIND_TASK
32 - OPENMP_EVENT_KIND_MASTER
33 - OPENMP_EVENT_KIND_REDUCTION
34 - OPENMP_EVENT_KIND_MUTEX_WAIT
35 - OPENMP_EVENT_KIND_CRITICAL_SECTION
36 - OPENMP_EVENT_KIND_WORKSHARE
```

OpenMP thread type values

```
1 - OpenMP Initial Thread
2 - OpenMP Worker Thread
3 - OpenMP Internal Thread
4 - Unknown
```

OpenMP sync region kind values

```
1 - Barrier
2 - Implicit barrier
3 - Explicit barrier
4 - Implementation-dependent barrier
5 - Taskwait
6 - Taskgroup
```

OpenMP task kind values

```
1 - Initial task
2 - Implicit task
3 - Explicit task
```

OpenMP prior task status values

```
1 - Task completed
2 - Task yielded to another task
3 - Task was cancelled
7 - Task was switched out for other reasons
```

OpenMP mutex kind values

```
1 - Waiting for lock
2 - Testing lock
3 - Waiting for nested lock
4 - Tesing nested lock
5 - Waitng for entering critical section region
6 - Waiting for entering atomic region
7 - Waiting for entering ordered region
```

OpenMP critical section kind values

```
5 - Critical section region
6 - Atomic region
7 - Ordered region
```

OpenMP workshare kind values

```
1 - Loop region
2 - Sections region
3 - Single region (executor)
4 - Single region (waiting)
5 - Workshare region
6 - Distrubute region
7 - Taskloop region
```

OpenMP dispatch kind values

```
1 - Iteration
2 - Section
```

3.3. Common SQLite Examples

Common Helper Commands

When utilizing sqlite3 command line tool, it's helpful to have data printed as named columns, this can be done with:

```
.mode column
.headers on
```

Default column width is determined by the data in the first row of results. If this doesn't work out well, you can specify widths manually.

```
.width 10 20 50
```

Obtaining Sample Report

CLI interface of Nsight Systems was used to profile radixSortThrust CUDA sample, then the resulting .nsys-rep file was exported using the nsys export.

```
nsys profile --trace=cuda,osrt radixSortThrust
nsys export --type sqlite report1.nsys-rep
```

Serialized Process and Thread Identifiers

Nsight Systems stores identifiers where events originated in serialized form. For events that have globalTid or globalPid fields exported, use the following code to extract numeric TID and PID.

```
SELECT globalTid / 0x1000000 % 0x1000000 AS PID, globalTid % 0x1000000 AS TID
 FROM TABLE_NAME;
```

Note: globalTid field includes both TID and PID values, while globalPid only containes the PID value.

Correlate CUDA Kernel Launches With CUDA API Kernel Launches

```
ALTER TABLE CUPTI_ACTIVITY_KIND_RUNTIME ADD COLUMN name TEXT;
ALTER TABLE CUPTI_ACTIVITY_KIND_RUNTIME ADD COLUMN kernelName TEXT;

UPDATE CUPTI_ACTIVITY_KIND_RUNTIME SET kernelName =
    (SELECT value FROM StringIds
    JOIN CUPTI_ACTIVITY_KIND_KERNEL AS cuda_gpu
        ON cuda_gpu.shortName = StringIds.id
        AND CUPTI_ACTIVITY_KIND_RUNTIME.correlationId = cuda_gpu.correlationId);

UPDATE CUPTI_ACTIVITY_KIND_RUNTIME SET name =
    (SELECT value FROM StringIds WHERE nameId = StringIds.id);
```

Select 10 longest CUDA API ranges that resulted in kernel execution.

```
SELECT name, kernelName, start, end FROM CUPTI_ACTIVITY_KIND_RUNTIME
    WHERE kernelName IS NOT NULL ORDER BY end - start LIMIT 10;
```

Results:

```
name                    kernelName                 start        end
----------------------  -----------------------    ----------   ----------
cudaLaunchKernel_v7000  RadixSortScanBinsKernel    658863435    658868490
cudaLaunchKernel_v7000  RadixSortScanBinsKernel    609755015    609760075
cudaLaunchKernel_v7000  RadixSortScanBinsKernel    632683286    632688349
cudaLaunchKernel_v7000  RadixSortScanBinsKernel    606495356    606500439
cudaLaunchKernel_v7000  RadixSortScanBinsKernel    603114486    603119586
cudaLaunchKernel_v7000  RadixSortScanBinsKernel    802729785    802734906
cudaLaunchKernel_v7000  RadixSortScanBinsKernel    593381170    593386294
cudaLaunchKernel_v7000  RadixSortScanBinsKernel    658759955    658765090
cudaLaunchKernel_v7000  RadixSortScanBinsKernel    681549917    681555059
cudaLaunchKernel_v7000  RadixSortScanBinsKernel    717812527    717817671
```

Remove Ranges Overlapping With Overhead

Use the this query to count CUDA API ranges overlapping with the overhead ones.

Replace "SELECT COUNT(*)" with "DELETE" to remove such ranges.

```
SELECT COUNT(*) FROM CUPTI_ACTIVITY_KIND_RUNTIME WHERE rowid IN
(
    SELECT cuda.rowid
    FROM PROFILER_OVERHEAD as overhead
    INNER JOIN CUPTI_ACTIVITY_KIND_RUNTIME as cuda ON
    (cuda.start BETWEEN overhead.start and overhead.end)
    OR (cuda.end BETWEEN overhead.start and overhead.end)
    OR (cuda.start < overhead.start AND cuda.end > overhead.end)
);
```

Results:

```
COUNT(*)
----------
1095
```

Find CUDA API Calls That Resulted in Original Graph Node Creation.

```
SELECT graph.graphNodeId, api.start, graph.start as graphStart, api.end,
    api.globalTid, api.correlationId, api.globalTid,
    (SELECT value FROM StringIds where api.nameId == id) as name
FROM CUPTI_ACTIVITY_KIND_RUNTIME as api
JOIN
    (
        SELECT start, graphNodeId, globalTid from CUDA_GRAPH_EVENTS
        GROUP BY graphNodeId
        HAVING COUNT(originalGraphNodeId) = 0
    ) as graph
ON api.globalTid == graph.globalTid AND api.start < graph.start AND api.end >
 graph.start
ORDER BY graphNodeId;
```

Results:

```
graphNodeId  start       graphStart  end         globalTid        correlationId
 globalTid        name
-----------  ----------  ----------  ----------  ---------------  -------------
 ---------------  ----------------------------
1            584366518   584378040   584379102   281560221750233  109
 281560221750233  cudaGraphAddMemcpyNode_v10000
2            584379402   584382428   584383139   281560221750233  110
 281560221750233  cudaGraphAddMemsetNode_v10000
3            584390663   584395352   584396053   281560221750233  111
 281560221750233  cudaGraphAddKernelNode_v10000
4            584396314   584397857   584398438   281560221750233  112
 281560221750233  cudaGraphAddMemsetNode_v10000
5            584398759   584400311   584400812   281560221750233  113
 281560221750233  cudaGraphAddKernelNode_v10000
6            584401083   584403047   584403527   281560221750233  114
 281560221750233  cudaGraphAddMemcpyNode_v10000
7            584403928   584404920   584405491   281560221750233  115
 281560221750233  cudaGraphAddHostNode_v10000
29           632107852   632117921   632121407   281560221750233  144
 281560221750233  cudaMemcpyAsync_v3020
30           632122168   632125545   632127989   281560221750233  145
 281560221750233  cudaMemsetAsync_v3020
31           632131546   632133339   632135584   281560221750233  147
 281560221750233  cudaMemsetAsync_v3020
34           632162514   632167393   632169297   281560221750233  151
 281560221750233  cudaMemcpyAsync_v3020
35           632170068   632173334   632175388   281560221750233  152
 281560221750233  cudaLaunchHostFunc_v10000
```

Backtraces for OSRT Ranges

Adding text columns makes results of the query below more human-readable.

```
ALTER TABLE OSRT_API ADD COLUMN name TEXT;
UPDATE OSRT_API SET name = (SELECT value FROM StringIds WHERE OSRT_API.nameId =
 StringIds.id);

ALTER TABLE OSRT_CALLCHAINS ADD COLUMN symbolName TEXT;
UPDATE OSRT_CALLCHAINS SET symbolName = (SELECT value FROM StringIds WHERE
 symbol = StringIds.id);

ALTER TABLE OSRT_CALLCHAINS ADD COLUMN moduleName TEXT;
UPDATE OSRT_CALLCHAINS SET moduleName = (SELECT value FROM StringIds WHERE
 module = StringIds.id);
```

Print backtrace of the longest OSRT range

```
SELECT globalTid / 0x1000000 % 0x1000000 AS PID, globalTid % 0x1000000 AS TID,
    start, end, name, callchainId, stackDepth, symbolName, moduleName
FROM OSRT_API LEFT JOIN OSRT_CALLCHAINS ON callchainId == OSRT_CALLCHAINS.id
WHERE OSRT_API.rowid IN (SELECT rowid FROM OSRT_API ORDER BY end - start DESC
 LIMIT 1)
ORDER BY stackDepth LIMIT 10;
```

Results:

```
PID         TID         start       end         name
 callchainId  stackDepth  symbolName                     moduleName

----------  ----------  ----------  ----------  ----------------------
  -----------  ----------  ------------------------------
 ----------------------------------------
19163       19176       360897690   860966851   pthread_cond_timedwait  88
          0           pthread_cond_timedwait@GLIBC_2  /lib/x86_64-linux-gnu/
libpthread-2.27.so
19163       19176       360897690   860966851   pthread_cond_timedwait  88
        1           0x7fbc983b7227                  /usr/lib/x86_64-linux-gnu/
libcuda.so.418
19163       19176       360897690   860966851   pthread_cond_timedwait  88
        2           0x7fbc9835d5c7                  /usr/lib/x86_64-linux-gnu/
libcuda.so.418
19163       19176       360897690   860966851   pthread_cond_timedwait  88
        3           0x7fbc983b64a8                  /usr/lib/x86_64-linux-gnu/
libcuda.so.418
19163       19176       360897690   860966851   pthread_cond_timedwait  88
          4           start_thread                    /lib/x86_64-linux-gnu/
libpthread-2.27.so
19163       19176       360897690   860966851   pthread_cond_timedwait  88
          5           __clone                         /lib/x86_64-linux-gnu/
libc-2.27.so
```

Profiled processes output streams

```
ALTER TABLE ProcessStreams ADD COLUMN filename TEXT;
UPDATE ProcessStreams SET filename = (SELECT value FROM StringIds WHERE
 ProcessStreams.filenameId = StringIds.id);

ALTER TABLE ProcessStreams ADD COLUMN content TEXT;
UPDATE ProcessStreams SET content = (SELECT value FROM StringIds WHERE
 ProcessStreams.contentId = StringIds.id);
```

Select all collected stdout and stderr streams.

```
select globalPid / 0x1000000 % 0x1000000 AS PID, filename, content from
 ProcessStreams;
```

Results:

```
PID         filename                                                        content



----------  -------------------------------------------------------
 -----------------------------------------------------------------------------------------------



19163       /tmp/nvidia/nsight_systems/streams/pid_19163_stdout.log  /home/
user_name/NVIDIA_CUDA-10.1_Samples/6_Advanced/radixSortThrust/radixSortThrust
 Starting...

GPU Device 0: "Quadro P2000" with compute capability 6.1


Sorting 1048576 32-bit unsigned int keys and values

radixSortThrust, Throughput = 401.0872 MElements/s, Time = 0.00261 s, Size =
 1048576 elements
Test passed

19163       /tmp/nvidia/nsight_systems/streams/pid_19163_stderr.log
```

Thread Summary

Please note, that Nsight Systems applies additional logic during sampling events processing to work around lost events. This means that the results of the below query might differ slightly from the ones shown in "Analysis summary" tab.

Thread summary calculated using CPU cycles (when available).

```
SELECT
    globalTid / 0x1000000 % 0x1000000 AS PID,
    globalTid % 0x1000000 AS TID,
    ROUND(100.0 * SUM(cpuCycles) /
        (
            SELECT SUM(cpuCycles) FROM COMPOSITE_EVENTS
            GROUP BY globalTid / 0x1000000000000 % 0x100
        ),
        2
    ) as CPU_utilization,
    (SELECT value FROM StringIds WHERE id =
        (
            SELECT nameId FROM ThreadNames
            WHERE ThreadNames.globalTid = COMPOSITE_EVENTS.globalTid
        )
    ) as thread_name
FROM COMPOSITE_EVENTS
GROUP BY globalTid
ORDER BY CPU_utilization DESC
LIMIT 10;
```

Results:

```
PID         TID         CPU_utilization  thread_name
----------  ----------  ---------------  ---------------
19163       19163       98.4             radixSortThrust
19163       19168       1.35             CUPTI worker th
19163       19166       0.25             [NS]
```

Thread running time may be calculated using scheduling data, when PMU counter data was not collected.

```
CREATE INDEX sched_start ON SCHED_EVENTS (start);

CREATE TABLE CPU_USAGE AS
SELECT
    first.globalTid as globalTid,
    (SELECT nameId FROM ThreadNames WHERE ThreadNames.globalTid =
 first.globalTid) as nameId,
    sum(second.start - first.start) as total_duration,
    count() as ranges_count
FROM SCHED_EVENTS as first
LEFT JOIN SCHED_EVENTS as second
ON second.rowid =
    (
        SELECT rowid
        FROM SCHED_EVENTS
        WHERE start > first.start AND globalTid = first.globalTid
        ORDER BY start ASC
        LIMIT 1
    )
WHERE first.isSchedIn != 0
GROUP BY first.globalTid
ORDER BY total_duration DESC;

SELECT
    globalTid / 0x1000000 % 0x1000000 AS PID,
    globalTid % 0x1000000 AS TID,
    (SELECT value FROM StringIds where nameId == id) as thread_name,
    ROUND(100.0 * total_duration / (SELECT SUM(total_duration) FROM CPU_USAGE),
 2) as CPU_utilization
FROM CPU_USAGE
ORDER BY CPU_utilization DESC;
```

Results:

```
PID         TID         thread_name      CPU_utilization
----------  ----------  ---------------  ---------------
19163       19163       radixSortThrust  93.74
19163       19169       radixSortThrust  3.22
19163       19168       CUPTI worker th  2.46
19163       19166       [NS]             0.44
19163       19172       radixSortThrust  0.07
19163       19167       [NS Comms]       0.05
19163       19176       radixSortThrust  0.02
19163       19170       radixSortThrust  0.0
```

Function Table

These examples demonstrate how to calculate Flat and BottomUp (for top level only) views statistics.

To set up:

```
ALTER TABLE SAMPLING_CALLCHAINS ADD COLUMN symbolName TEXT;
UPDATE SAMPLING_CALLCHAINS SET symbolName = (SELECT value FROM StringIds WHERE
 symbol = StringIds.id);

ALTER TABLE SAMPLING_CALLCHAINS ADD COLUMN moduleName TEXT;
UPDATE SAMPLING_CALLCHAINS SET moduleName = (SELECT value FROM StringIds WHERE
 module = StringIds.id);
```

To get flat view:

```
SELECT symbolName, moduleName, ROUND(100.0 * sum(cpuCycles) /
    (SELECT SUM(cpuCycles) FROM COMPOSITE_EVENTS), 2) AS flatTimePercentage
FROM SAMPLING_CALLCHAINS
LEFT JOIN COMPOSITE_EVENTS ON SAMPLING_CALLCHAINS.id == COMPOSITE_EVENTS.id
GROUP BY symbol, module
ORDER BY flatTimePercentage DESC
LIMIT 5;
```

To get BottomUp view (top level only):

```
SELECT symbolName, moduleName, ROUND(100.0 * sum(cpuCycles) /
    (SELECT SUM(cpuCycles) FROM COMPOSITE_EVENTS), 2) AS selfTimePercentage
FROM SAMPLING_CALLCHAINS
LEFT JOIN COMPOSITE_EVENTS ON SAMPLING_CALLCHAINS.id == COMPOSITE_EVENTS.id
WHERE stackDepth == 0
GROUP BY symbol, module
ORDER BY selfTimePercentage DESC
LIMIT 5;
```

Results:

```
symbolName   moduleName   flatTimePercentage
-----------  -----------  ------------------
[Max depth]  [Max depth]  99.92
thrust::zip  /home/user_  24.17
thrust::zip  /home/user_  24.17
thrust::det  /home/user_  24.17
thrust::det  /home/user_  24.17
symbolName      moduleName                                  selfTimePercentage
--------------  ------------------------------------------  ------------------
0x7fbc984982b6  /usr/lib/x86_64-linux-gnu/libcuda.so.418.39  5.29
0x7fbc982d0010  /usr/lib/x86_64-linux-gnu/libcuda.so.418.39  2.81
thrust::iterat  /home/user_name/NVIDIA_CUDA-10.1_Samples/6_  2.23
thrust::iterat  /home/user_name/NVIDIA_CUDA-10.1_Samples/6_  1.55
void thrust::i  /home/user_name/NVIDIA_CUDA-10.1_Samples/6_  1.55
```

DX12 API Frame Duration Histogram

The example demonstrates how to calculate DX12 CPU frames durartion and construct a histogram out of it.

```
CREATE INDEX DX12_API_ENDTS ON DX12_API (end);

CREATE TEMP VIEW DX12_API_FPS AS SELECT end AS start,
    (SELECT end FROM DX12_API
        WHERE end > outer.end AND nameId == (SELECT id FROM StringIds
            WHERE value == "IDXGISwapChain::Present")
        ORDER BY end ASC LIMIT 1) AS end
FROM DX12_API AS outer
    WHERE nameId == (SELECT id FROM StringIds WHERE value ==
 "IDXGISwapChain::Present")
ORDER BY end;
```

Number of frames with a duration of [X, X + 1) milliseconds.

```
SELECT
    CAST((end - start) / 1000000.0 AS INT) AS duration_ms,
    count(*)
FROM DX12_API_FPS
WHERE end IS NOT NULL
GROUP BY duration_ms
ORDER BY duration_ms;
```

Results:

```
duration_ms  count(*)
-----------  ----------
3            1
4            2
5            7
6            153
7            19
8            116
9            16
10           8
11           2
12           2
13           1
14           4
16           3
17           2
18           1
```

GPU Context Switch Events Enumeration

GPU context duration is between first BEGIN and a matching END event.

```
SELECT (CASE tag WHEN 8 THEN "BEGIN" WHEN 7 THEN "END" END) AS tag,
    globalPid / 0x1000000 % 0x1000000 AS PID,
    vmId, seqNo, contextId, timestamp, gpuId FROM FECS_EVENTS
WHERE tag in (7, 8) ORDER BY seqNo LIMIT 10;
```

Results:

```
tag         PID         vmId        seqNo       contextId   timestamp   gpuId
----------  ----------  ----------  ----------  ----------  ----------
 ----------
BEGIN       23371       0           0           1048578     56759171    0
BEGIN       23371       0           1           1048578     56927765    0
BEGIN       23371       0           3           1048578     63799379    0
END         23371       0           4           1048578     63918806    0
BEGIN       19397       0           5           1048577     64014692    0
BEGIN       19397       0           6           1048577     64250369    0
BEGIN       19397       0           8           1048577     1918310004  0
END         19397       0           9           1048577     1918521098  0
BEGIN       19397       0           10          1048577     2024164744  0
BEGIN       19397       0           11          1048577     2024358650  0
```

Resolve NVTX Category Name

The example demonstrates how to resolve NVTX category name for NVTX marks and ranges.

```
WITH
  event AS (
    SELECT *
    FROM NVTX_EVENTS
    WHERE eventType IN (34, 59, 60) -- mark, push/pop, start/end
  ),
  category AS (
    SELECT
      category,
      domainId,
      text AS categoryName
    FROM NVTX_EVENTS
    WHERE eventType == 33 --  new category
  )
SELECT
  start,
  end,
  globalTid,
  eventType,
  domainId,
  category,
  categoryName,
  text
FROM event JOIN category USING (category, domainId)
ORDER BY start;
```

Results:

```
start       end         globalTid        eventType   domainId    category
 categoryName               text
----------  ----------  ---------------  ----------  ----------  ----------
 -------------------------  ----------------
18281150    18311960    281534938484214  59          0           1
 FirstCategoryUnderDefault  Push Pop Range A
18288187    18306674    281534938484214  59          0           2
 SecondCategoryUnderDefaul  Push Pop Range B
18294247                281534938484214  34          0           1
 FirstCategoryUnderDefault  Mark A
18300034                281534938484214  34          0           2
 SecondCategoryUnderDefaul  Mark B
18345546    18372595    281534938484214  60          1           1
 FirstCategoryUnderMyDomai  Start End Range
18352924    18378342    281534938484214  60          1           2
 SecondCategoryUnderMyDoma  Start End Range
18359634                281534938484214  34          1           1
 FirstCategoryUnderMyDomai  Mark A
18365448                281534938484214  34          1           2
 SecondCategoryUnderMyDoma  Mark B
```

Rename CUDA Kernels with NVTX

The example demonstrates how to map innermost NVTX push-pop range to a matching CUDA kernel run.

```
ALTER TABLE CUPTI_ACTIVITY_KIND_KERNEL ADD COLUMN nvtxRange TEXT;
CREATE INDEX nvtx_start ON NVTX_EVENTS (start);


UPDATE CUPTI_ACTIVITY_KIND_KERNEL SET nvtxRange = (
    SELECT NVTX_EVENTS.text
    FROM NVTX_EVENTS JOIN CUPTI_ACTIVITY_KIND_RUNTIME ON
        NVTX_EVENTS.eventType == 59 AND
        NVTX_EVENTS.globalTid == CUPTI_ACTIVITY_KIND_RUNTIME.globalTid AND
        NVTX_EVENTS.start <= CUPTI_ACTIVITY_KIND_RUNTIME.start AND
        NVTX_EVENTS.end >= CUPTI_ACTIVITY_KIND_RUNTIME.end
    WHERE
        CUPTI_ACTIVITY_KIND_KERNEL.correlationId ==
 CUPTI_ACTIVITY_KIND_RUNTIME.correlationId
    ORDER BY NVTX_EVENTS.start DESC LIMIT 1
);

SELECT start, end, globalPid, StringIds.value as shortName, nvtxRange
FROM CUPTI_ACTIVITY_KIND_KERNEL JOIN StringIds ON shortName == id
ORDER BY start LIMIT 6;
```

Results:

```
start       end         globalPid          shortName      nvtxRange
----------  ----------  -----------------  -------------  ----------
526545376   526676256   72057700439031808  MatrixMulCUDA
526899648   527030368   72057700439031808  MatrixMulCUDA  Add
527031648   527162272   72057700439031808  MatrixMulCUDA  Add
527163584   527294176   72057700439031808  MatrixMulCUDA  My Kernel
527296160   527426592   72057700439031808  MatrixMulCUDA  My Range
527428096   527558656   72057700439031808  MatrixMulCUDA
```

Select CUDA Calls With Backtraces

```
ALTER TABLE CUPTI_ACTIVITY_KIND_RUNTIME ADD COLUMN name TEXT;
UPDATE CUPTI_ACTIVITY_KIND_RUNTIME SET name = (SELECT value FROM StringIds WHERE
 CUPTI_ACTIVITY_KIND_RUNTIME.nameId = StringIds.id);

ALTER TABLE CUDA_CALLCHAINS ADD COLUMN symbolName TEXT;
UPDATE CUDA_CALLCHAINS SET symbolName = (SELECT value FROM StringIds WHERE
 symbol = StringIds.id);

SELECT globalTid % 0x1000000 AS TID,
    start, end, name, callchainId, stackDepth, symbolName
FROM CUDA_CALLCHAINS JOIN CUPTI_ACTIVITY_KIND_RUNTIME ON callchainId ==
 CUDA_CALLCHAINS.id
ORDER BY callchainId, stackDepth LIMIT 11;
```

Results:

```
TID         start       end         name           callchainId  stackDepth
 symbolName
----------  ----------  ----------  -------------  -----------  ----------
 --------------
11928       168976467   169077826   cuMemAlloc_v2  1            0
 0x7f13c44f02ab
11928       168976467   169077826   cuMemAlloc_v2  1            1
 0x7f13c44f0b8f
11928       168976467   169077826   cuMemAlloc_v2  1            2
 0x7f13c44f3719
11928       168976467   169077826   cuMemAlloc_v2  1            3
 cuMemAlloc_v2
11928       168976467   169077826   cuMemAlloc_v2  1            4
 cudart::driver
11928       168976467   169077826   cuMemAlloc_v2  1            5
 cudart::cudaAp
11928       168976467   169077826   cuMemAlloc_v2  1            6
 cudaMalloc
11928       168976467   169077826   cuMemAlloc_v2  1            7
 cudaError cuda
11928       168976467   169077826   cuMemAlloc_v2  1            8            main

11928       168976467   169077826   cuMemAlloc_v2  1            9
 __libc_start_m
11928       168976467   169077826   cuMemAlloc_v2  1            10
 _start
```

SLI Peer-to-Peer Query

The example demonstrates how to query SLI Peer-to-Peer events with resource size greater than value and within a time range sorted by resource size descending.

```
SELECT *
FROM SLI_P2P
WHERE resourceSize < 98304 AND start > 1568063100 AND end < 1579468901
ORDER BY resourceSize DESC;
```

Results:

```
start       end         eventClass  globalTid          gpu         frameId
     transferSkipped  srcGpu      dstGpu      numSubResources  resourceSize
  subResourceIdx  smplWidth   smplHeight  smplDepth   bytesPerElement
 dxgiFormat  logSurfaceNames  transferInfo  isEarlyPushManagedByNvApi
 useAsyncP2pForResolve  transferFuncName  regimeName  debugName   bindType
----------  ----------  ----------  -----------------  ----------  ----------
  ---------------  ----------  ----------  ---------------  ------------
  --------------  ----------  ----------  ----------  ---------------
 ----------  ---------------  ------------  -------------------------
 ---------------------  ----------------  ----------  ----------  ----------
1570351100  1570351101  62          72057698056667136  0           771         0
                256         512         1                1048576       0
       256         256         1           16              2
         3            0                           0

1570379300  1570379301  62          72057698056667136  0           771         0
                256         512         1                1048576       0
       64          64          64          4               31
         3            0                           0

1572316400  1572316401  62          72057698056667136  0           773         0
                256         512         1                1048576       0
       256         256         1           16              2
         3            0                           0

1572345400  1572345401  62          72057698056667136  0           773         0
                256         512         1                1048576       0
       64          64          64          4               31
         3            0                           0

1574734300  1574734301  62          72057698056667136  0           775         0
                256         512         1                1048576       0
       256         256         1           16              2
         3            0                           0

1574767200  1574767201  62          72057698056667136  0           775         0
                256         512         1                1048576       0
       64          64          64          4               31
         3            0                           0
```

Generic Events

Syscall usage histogram by PID:

```
SELECT json_extract(data, '$.common_pid') AS PID, count(*) AS total
FROM GENERIC_EVENTS WHERE PID IS NOT NULL AND typeId = (
  SELECT typeId FROM GENERIC_EVENT_TYPES
  WHERE json_extract(data, '$.Name') = "raw_syscalls:sys_enter")
GROUP BY PID
ORDER BY total DESC
LIMIT 10;
```

Results:

```
PID         total
----------  ----------
5551        32811
9680        3988
4328        1477
9564        1246
4376        1204
4377        1167
4357        656
4355        655
4356        640
4354        633
```

Fetching Generic Events in JSON Format

Text and JSON export modes don't include generic events. Use the below queries (without LIMIT clause) to extract JSON lines representation of generic events, types and sources.

```
SELECT json_insert('{}',
    '$.sourceId', sourceId,
    '$.data', json(data)
)
FROM GENERIC_EVENT_SOURCES LIMIT 2;

SELECT json_insert('{}',
    '$.typeId', typeId,
    '$.sourceId', sourceId,
    '$.data', json(data)
)
FROM GENERIC_EVENT_TYPES LIMIT 2;

SELECT json_insert('{}',
    '$.rawTimestamp', rawTimestamp,
    '$.timestamp', timestamp,
    '$.typeId', typeId,
    '$.data', json(data)
)
FROM GENERIC_EVENTS LIMIT 2;
```

Results:

```
json_insert('{}',
    '$.sourceId', sourceId,
    '$.data', json(data)
)
-----------------------------------------------------------------------------------------------------------------
{"sourceId":72057602627862528,"data":
{"Name":"FTrace","TimeSource":"ClockMonotonicRaw","SourceGroup":"FTrace"}}
json_insert('{}',
    '$.typeId', typeId,
    '$.sourceId', sourceId,
    '$.data', json(data)
)


-----------------------------------------------------------------------------------------------------------------




{"typeId":72057602627862547,"sourceId":72057602627862528,"data":
{"Name":"raw_syscalls:sys_enter","Format":"\"NR %ld (%lx,
 %lx, %lx, %lx, %lx, %lx)\", REC->id, REC->args[0], REC-
>args[1], REC->args[2], REC->args[3], REC->args[4], REC-
>args[5]","Fields":[{"Name":"common_pid","Prefix":"int","Suffix":""},
{"Name":"id","Prefix":"long","S
{"typeId":72057602627862670,"sourceId":72057602627862528,"data":
{"Name":"irq:irq_handler_entry","Format":"\"irq=%d name=%s\", REC->irq,
 __get_str(name)","Fields":[{"Name":"common_pid","Prefix":"int","Suffix":""},
{"Name":"irq","Prefix":"int","Suffix":""},{"Name":"name","Prefix":"__data_loc
 char[]","Suffix":""},{"Name":"common_type",
json_insert('{}',
    '$.rawTimestamp', rawTimestamp,
    '$.timestamp', timestamp,
    '$.typeId', typeId,
    '$.data', json(data)
)
-----------------------------------------------------------------------------------------------------------------


{"rawTimestamp":1183694330725221,"timestamp":6236683,"typeId":72057602627862670,"data":
{"common_pid":"0","irq":"66","name":"327696","common_type":"142","common_flags":"9","common_p
{"rawTimestamp":1183694333695687,"timestamp":9207149,"typeId":72057602627862670,"data":
{"common_pid":"0","irq":"66","name":"327696","common_type":"142","common_flags":"9","common_p
```

3.4. Arrow Format Description

The Arrow type exported file uses the IPC stream format to store the data in a file. The tables can be read by opening the file as an arrow stream. For example one can use the **`open_stream`** function from the arrow python package. For more information on the interfaces that can be used to read an IPC stream file, please refer to the Apache Arrow documentation [1, 2].

The name of each table is included in the schema metadata. Thus, while reading each table, the user can extract the table title from the metadata. The table name metadata field has the key **`table_name`**. The titles of all the available tables can be found in section SQLite Schema Reference.

3.5. JSON and Text Format Description

JSON and TXT export formats are generated by serializing buffered messages, each on a new line. First, all collected events are processed. Then strings are serialized, followed by stdout, stderr streams if any, followed by thread names.

Output layout:

```
{Event #1}
{Event #2}
...
{Event #N}
{Strings}
{Streams}
{Threads}
```

For easier grepping of JSON output, the **`--separate-strings`** switch may be used to force manual splitting of strings, streams and thread names data.

Example line split: **`nsys export --export-json --separate-strings sample.nsys-rep -- -`**

```
{"type":"String","id":"3720","value":"Process 14944 was launched by the
 profiler"}
{"type":"String","id":"3721","value":"Profiling has started."}
{"type":"String","id":"3722","value":"Profiler attached to the process."}
{"type":"String","id":"3723","value":"Profiling has stopped."}
{"type":"ThreadName","globalTid":"72057844756653436","nameId":"14","priority":"10"}
{"type":"ThreadName","globalTid":"72057844756657940","nameId":"15","priority":"10"}
{"type":"ThreadName","globalTid":"72057844756654400","nameId":"24","priority":"10"}
```

Compare with: **`nsys export --export-json sample.nsys-rep -- -`**

```
{"data":["[Unknown]","[Unknown kernel module]","[Max depth]","[Broken
 backtraces]",
  "[Called from
 Java]","QnxKernelTrace","mm_","task_submit","class_id","syncpt_id",
  "syncpt_thresh","pid","tid","FTrace","[NSys]","[NSys Comms]", "..." ,"Process
  14944 was launched by the profiler","Profiling has started.","Profiler
 attached
  to the process.","Profiling has stopped."]}
{"data":[{"nameIdx":"14","priority":"10","globalTid":"72057844756653436"},
  {"nameIdx":"15","priority":"10","globalTid":"72057844756657940"},
{"nameIdx":"24",
  "priority":"10","globalTid":"72057844756654400"}]}
```

Note, that only last few lines are shown here for clarity and that carriage returns and indents were added to avoid wrapping documentation.

Chapter 4. REPORT SCRIPTS

Report Scripts Shipped With Nsight Systems

The Nsight Systems development team created and maintains a set of report scripts for some of the commonly requested reports. These scripts will be updated to adapt to any changes in SQLite schema or internal data structures.

These scripts are located in the Nsight Systems package in the Target-<architecture>/reports directory. The following standard reports are available:

apigpusum[:base] -- CUDA API & GPU Summary (CUDA API + kernels + memory ops)

Arguments

- **base** - Optional argument, if given, will cause summary to be over the base name of the kernel, rather than the templated name.

Output: All time values given in nanoseconds

- **Time(%)** : Percentage of **Total Time**
- **Total Time** : The total time used by all executions of this kernel
- **Instances**: The number of executions of this object
- **Average** : The average execution time of this kernel
- **Minimum** : The smallest execution time of this kernel
- **Maximum** : The largest execution time of this kernel
- **Category** : The category of the operation
- **Operation** : The name of the kernel

This report provides a summary of CUDA API calls, kernels and memory operations, and their execution times. Note that the **Time(%)** column is calculated using a summation of the **Total Time** column, and represents that API call's, kernel's, or memory operation's percent of the execution time of the APIs, kernels and memory operations listed, and not a percentage of the application wall or CPU execution time.

This report combines data from the **`cudaapisum`**, **`gpukernsum`**, and **`gpumemsizesum`** reports. It is very similar to profile section of **`nvprof --dependency-analysis`**.

cudaapisum -- CUDA API Summary

Arguments - None

Output: All time values given in nanoseconds

- **Time(%)** : Percentage of **Total Time**
- **Total Time** : The total time used by all executions of this function
- **Num Calls** : The number of calls to this function
- **Average** : The average execution time of this function
- **Minimum** : The smallest execution time of this function
- **Maximum** : The largest execution time of this function
- **Name** : The name of the function

This report provides a summary of CUDA API functions and their execution times. Note that the **Time(%)** column is calculated using a summation of the **Total Time** column, and represents that function's percent of the execution time of the functions listed, and not a percentage of the application wall or CPU execution time.

cudaapitrace -- CUDA API Trace

Arguments - None

Output: All time values given in nanoseconds

- **Start** : Timestamp when API call was made
- **Duration** : Length of API calls
- **Name** : API function name
- **Result** : return value of API call
- **CorrID** : Correlation used to map to other CUDA calls
- **Pid** : Process ID that made the call
- **Tid** : Thread ID that made the call
- **T-Pri** : Run priority of call thread
- **Thread Name** : Name of thread that called API function

This report provides a trace record of CUDA API function calls and their execution times.

gpukernsum[:base] -- CUDA GPU Kernel Summary

Arguments

- **base** - Optional argument, if given, will cause summary to be over the base name of the kernel, rather than the templated name.

Output: All time values given in nanoseconds

- **Time(%)** : Percentage of **Total Time**

- **Total Time** : The total time used by all executions of this kernel
- **Instances** : The number of calls to this kernel
- **Average** : The average execution time of this kernel
- **Minimum** : The smallest execution time of this kernel
- **Maximum** : The largest execution time of this kernel
- **Name** : The name of the kernel

This report provides a summary of CUDA kernels and their execution times. Note that the **Time(%)** column is calculated using a summation of the **Total Time** column, and represents that kernel's percent of the execution time of the kernels listed, and not a percentage of the application wall or CPU execution time.

gpumemsizesum -- GPU Memory Operations Summary (by Size)

Arguments - None

Output: All memory values given in KiB

- **Total** : Total number of KiB utilized by this operation
- **Operations** : Number of executions of this operation
- **Average** : The average memory size of this operation
- **Minimum** : The smallest memory size of this operation
- **Maximum** : The largest memory size of this operation
- **Name** : The name of the operation

This report provides a summary of GPU memory operations and the amount of memory they utilize.

gpumemtimesum -- GPU Memory Operations Summary (by Time)

Arguments - None

Output: All memory values given in KiB

- **Time(%)** : Percentage of **Total Time**
- **Total Time** : The total time used by all executions of this operation
- **Operations**: The number of operations of this type
- **Average** : The average execution time of this operation
- **Minimum** : The smallest execution time of this operation
- **Maximum** : The largest execution time of this operation
- **Operation** : The name of the memory operation

This report provides a summary of GPU memory operations and their execution times. Note that the **Time(%)** column is calculated using a summation of the **Total Time** column, and represents that operation's percent of the execution time of the operations listed, and not a percentage of the application wall or CPU execution time.

gpusum[:base] -- GPU Summary (kernels + memory operations)

Arguments

- **base** - Optional argument, if given, will cause summary to be over the base name of the kernel, rather than the templated name.

Output: All time values given in nanoseconds

- **Time(%)** : Percentage of **Total Time**
- **Total Time** : The total time used by all executions of this kernel
- **Instances** : The number of executions of this object
- **Average** : The average execution time of this kernel
- **Minimum** : The smallest execution time of this kernel
- **Maximum** : The largest execution time of this kernel
- **Category** : The category of the operation
- **Name** : The name of the kernel

This report provides a summary of CUDA kernels and memory operations, and their execution times. Note that the **Time(%)** column is calculated using a summation of the **Total Time** column, and represents that kernel's or memory operation's percent of the execution time of the kernels and memory operations listed, and not a\ percentage of the application wall or CPU execution time.

This report combines data from the **`gpukernsum`** and **`gpumemtimesum`** reports. This report is very similar to output of the command **`nvprof --print-gpu-summary`**.

gputrace -- CUDA GPU Trace

Arguments - None

Output:

- **Start** : Start time of trace event in seconds
- **Duration** : Length of event in nanoseconds
- **CorrId** : Correlation ID
- **GrdX, GrdY, GrdZ** : Grid values
- **BlkX, BlkY, BlkZ** : Block values
- **Reg/Trd** : Registers per thread
- **StcSMem** : Size of Static Shared Memory
- **DymSMem** : Size of Dynamic Shared Memory
- **Bytes** : Size of memory operation
- **Thru** : Throughput in MB per Second
- **SrcMemKd** : Memcpy source memory kind or memset memory kind
- **DstMemKd** : Memcpy destination memory kind
- **Device** : GPU device name and ID
- **Ctx** : Context ID

- **Strm** : Stream ID
- **Name** : Trace event name

This report displays a trace of CUDA kernels and memory operations. Items are sorted by start time.

nvtxppsum -- NVTX Push/Pop Range Summary

Arguments - None

Output: All time values given in nanoseconds

- **Time(%)** : Percentage of **Total Time**
- **Total Time** : The total time used by all instances of this range
- **Instances** : The number of instances of this range
- **Average** : The average execution time of this range
- **Minimum** : The smallest execution time of this range
- **Maximum** : The largest execution time of this range
- **Range** : The name of the range

This report provides a summary of NV Tools Extensions Push/Pop Ranges and their execution times. Note that the **Time(%)** column is calculated using a summation of the **Total Time** column, and represents that range's percent of the execution time of the ranges listed, and not a percentage of the application wall or CPU execution time.

openmpevtsum -- OpenMP Event Summary

Arguments - None

Output: All time values given in nanoseconds

- **Time(%)** : Percentage of **Total Time**
- **Total Time** : The total time used by all executions of event type
- **Count** : The number of event type
- **Average** : The average execution time of event type
- **Minimum** : The smallest execution time of event type
- **Maximum** : The largest execution time of event type
- **Name** : The name of the event

This report provides a summary of OpenMP events and their execution times. Note that the **Time(%)** column is calculated using a summation of the **Total Time** column, and represents that event type's percent of the execution time of the events listed, and not a percentage of the application wall or CPU execution time.

osrtsum -- OS Runtime Summary

Arguments - None

Output: All time values given in nanoseconds

- **Time(%)** : Percentage of **Total Time**

- **Total Time** : The total time used by all executions of this function
- **Num Calls** : The number of calls to this function
- **Average** : The average execution time of this function
- **Minimum** : The smallest execution time of this function
- **Maximum** : The largest execution time of this function
- **Name** : The name of the function

This report provides a summary of operating system functions and their execution times. Note that the **Time(%)** column is calculated using a summation of the **Total Time** column, and represents that function's percent of the execution time of the functions listed, and not a percentage of the application wall or CPU execution time.

vulkanmarkerssum -- Vulkan Range Summary

Arguments - None

Output: All time values given in nanoseconds

- **Time(%)** : Percentage of **Total Time**
- **Total Time** : The total time used by all executions of this function
- **Instances** : The number of instances of this range
- **Average** : The average execution time of this function
- **Minimum** : The smallest execution time of this function
- **Maximum** : The largest execution time of this function
- **StdDev** : The standard deviation of execution time of this range
- **Range** : The name of the range

This report provides a summary of Vulkan debug markers on the CPU, and their execution times. Note that the **Time(%)** column is calculated using a summation of the **Total Time** column, and represents that function's percent of the execution time of the functions listed, and not a percentage of the application wall or CPU execution time.

pixsum -- PIX Range Summary

Arguments - None

Output: All time values given in nanoseconds

- **Time(%)** : Percentage of **Total Time**
- **Total Time** : The total time used by all executions of this function
- **Instances** : The number of instances of this range
- **Average** : The average execution time of this function
- **Minimum** : The smallest execution time of this function
- **Maximum** : The largest execution time of this function
- **StdDev** : The standard deviation of execution time of this range
- **Range** : The name of the range

This report provides a summary of PIX CPU debug markers, and their execution times. Note that the **Time(%)** column is calculated using a summation of the **Total Time** column, and represents that function's percent of the execution time of the functions listed, and not a percentage of the application wall or CPU execution time.

khrdebugsum -- OpenGL KHR_debug Range Summary

Arguments - None

Output: All time values given in nanoseconds

- **Time(%)** : Percentage of **Total Time**
- **Total Time** : The total time used by all executions of this function
- **Instances** : The number of instances of this range
- **Average** : The average execution time of this function
- **Minimum** : The smallest execution time of this function
- **Maximum** : The largest execution time of this function
- **StdDev** : The standard deviation of execution time of this range
- **Range** : The name of the range

This report provides a summary of OpenGL KHR_debug CPU PUSH/POP debug Ranges, and their execution times. Note that the **Time(%)** column is calculated using a summation of the **Total Time** column, and represents that function's percent of the execution time of the functions listed, and not a percentage of the application wall or CPU execution time.

Report Formatters Shipped With Nsight Systems

The following formats are available in Nsight Systems

Column

Usage:

`column[:nohdr][:nolimit][:nofmt][:<width>[:<width>]...]`

Arguments

- nohdr : Do not display the header
- nolimit : Remove 100 character limit from auto-width columns Note: This can result in extremely wide columns.
- nofmt : Do not reformat numbers.
- <width>... : Define the explicit width of one or more columns. If the value "." is given, the column will auto-adjust. If a width of 0 is given, the column will not be displayed.

The column formatter presents data in vertical text columns. It is primarily designed to be a human-readable format for displaying data on a console display.

Text data will be left-justified, while numeric data will be right-justified. If the data overflows the available column width, it will be marked with a "…" character, to indicate the data values were clipped. Clipping always occurs on the right-hand side, even for numeric data.

Numbers will be reformatted to make easier to visually scan and understand. This includes adding thousands-separators. This process requires that the string representation of the number is converted into its native representation (integer or floating point) and then converted back into a string representation to print. This conversion process attempts to preserve elements of number presentation, such as the number of decimal places, or the use of scientific notation, but the conversion is not always perfect (the number should always be the same, but the presentation may not be). To disable the reformatting process, use the argument **`nofmt`**.

If no explicit width is given, the columns auto-adjust their width based off the header size and the first 100 lines of data. This auto-adjustment is limited to a maximum width of 100 characters. To allow larger auto-width columns, pass the initial argument **`nolimit`**. If the first 100 lines do not calculate the correct column width, it is suggested that explicit column widths be provided.

Table

Usage:

`table[:nohdr][:nolimit][:nofmt][:<width>[:<width>]...]`

Arguments

- nohdr : Do not display the header
- nolimit : Remove 100 character limit from auto-width columns Note: This can result in extremely wide columns.
- nofmt : Do not reformat numbers.
- <width>... : Define the explicit width of one or more columns. If the value "." is given, the column will auto-adjust. If a width of 0 is given, the column will not be displayed.

The table formatter presents data in vertical text columns inside text boxes. Other than the lines between columns, it is identical to the **column** formatter.

CSV

Usage:

`csv[:nohdr]`

Arguments

- nohdr : Do not display the header

The csv formatter outputs data as comma-separated values. This format is commonly used for import into other data applications, such as spread-sheets and databases.

There are many different standards for CSV files. Most differences are in how escapes are handled, meaning data values that contain a comma or space.

This CSV formatter will escape commas by surrounding the whole value in double-quotes.

TSV

Usage:

`tsv[:nohdr][:esc]`

Arguments

- nohdr : Do not display the header
- esc : escape tab characters, rather than removing them

The tsv formatter outputs data as tab-separated values. This format is sometimes used for import into other data applications, such as spreadsheets and databases.

Most TSV import/export systems disallow the tab character in data values. The formatter will normally replace any tab characters with a single space. If the **`esc`** argument has been provided, any tab characters will be replaced with the literal characters "\t".

JSON

Usage:

`json`

Arguments: no arguments

The json formatter outputs data as an array of JSON objects. Each object represents one line of data, and uses the column names as field labels. All objects have the same fields. The formatter attempts to recognize numeric values, as well as JSON keywords, and converts them. Empty values are passed as an empty string (and not nil, or as a missing field).

At this time the formatter does not escape quotes, so if a data value includes double-quotation marks, it will corrupt the JSON file.

HDoc

Usage:

`hdoc[:title=<title>][:css=<URL>]`

Arguments:

- title : string for HTML document title
- css : URL of CSS document to include

The hdoc formatter generates a complete, verifiable (mostly), standalone HTML document. It is designed to be opened in a web browser, or included in a larger document via an <iframe>.

HTable

Usage:

`htable`

Arguments: no arguments

The htable formatter outputs a raw HTML <table> without any of the surrounding HTML document. It is designed to be included into a larger HTML document. Although most web browsers will open and display the document, it is better to use the **hdoc** format for this type of use.

Chapter 5.
MIGRATING FROM NVIDIA NVPROF

Using the Nsight Systems CLI nvprof Command

The **`nvprof`** command of the Nsight Systems CLI is intended to help former nvprof users transition to nsys. Many nvprof switches are not supported by nsys, often because they are now part of NVIDIA Nsight Compute.

The full nvprof documentation can be found at https://docs.nvidia.com/cuda/profiler-users-guide.

The nvprof transition guide for Nsight Compute can be found at https://docs.nvidia.com/nsight-compute/NsightComputeCli/index.html#nvprof-guide.

Any nvprof switch not listed below is not supported by the **`nsys nvprof`** command. No additional nsys functionality is available through this command. New features will not be added to this command in the future.

CLI nvprof Command Switch Options

After choosing the **`nvprof`** command switch, the following options are available. When you are ready to move to using Nsight Systems CLI directly, see Command Line Options documentation for the nsys switch(es) given below. Note that the nsys implementation and output may vary from nvprof.

Usage.

```
nsys nvprof [options]
```

Switch	Parameters (Default in Bold)	nsys switch	Switch Description
--annotate-mpi	**off**, openmpi, mpich	--trace=mpi AND --mpi-impl	Automatically annotate MPI calls with NVTX markers. Specify the MPI

Switch	Parameters (Default in Bold)	nsys switch	Switch Description
			implementation installed on your machine. Only OpenMPI and MPICH implementations are supported.
--cpu-thread-tracing	on, **off**	--trace=osrt	Collect information about CPU thread API activity.
--profile-api-trace	none, runtime, driver,**all**	--trace=cuda	Turn on/off CUDA runtime and driver API tracing. For Nsight Systems there is no separate CUDA runtime and CUDA driver trace, so selecting **`runtime`** or **`driver`** is equivalent to selecting **`all`** .
--profile-from-start	**on**, off	if off use --capture-range=cudaProfilerApi	Enable/disable profiling from the start of the application. If disabled, the application can use {cu,cuda}Profiler{Start,Stop} to turn on/off profiling.
-t,--timeout	<nanoseconds> default=**0**	--duration=seconds	If greater than 0, stop the collection and kill the launched application after timeout seconds. nvprof started counting when the CUDA driver is initialized. nsys starts counting immediately.

Switch	Parameters (Default in Bold)	nsys switch	Switch Description
--cpu-profiling	on, **off**	--sampling=cpu	Turn on/off CPU profiling
--openacc-profiling	**on**, off	--trace=openacc to turn on	Enable/disable recording information from the OpenACC profiling interface. Note: OpenACC profiling interface depends on the presence of the OpenACC runtime. For supported runtimes, see **CUDA Trace** section of documentation
-o, --export-profile	<filename>	--output={filename} and/or --export=sqlite	Export named file to be imported or opened in the Nsight Systems GUI. %q{ENV_VAR} in string will be replaced with the set value of the environment variable. If not set this is an error. %h in the string is replaced with the system hostname. %% in the string is replaced with %. %p in the string is not supported currently. Any other character following % is illegal. The default is report1, with the number incrementing to avoid overwriting files, in users working directory.

Switch	Parameters (Default in Bold)	nsys switch	Switch Description
-f, --force-overwrite		--force-overwrite=true	Force overwriting all output files with same name.
-h, --help		--help	Print Nsight Systems CLI help
-V, --version		--version	Print Nsight Systems CLI version information

Next Steps

NVIDIA Visual Profiler (NVVP) and NVIDIA nvprof are deprecated. New GPUs and features will not be supported by those tools. We encourage you to make the move to Nsight Systems now. For additional information, suggestions, and rationale, see the blog series in Other Resources.

Chapter 6.
PROFILING IN A DOCKER ON LINUX DEVICES

Collecting data within a Docker

The following information assumes the reader is knowledgeable regarding Docker containers. For further information about Docker use in general, see the Docker documentation.

Enable Docker Collection

When starting the Docker to perform a Nsight Systems collection, additional steps are required to enable the **`perf_event_open`** system call. This is required in order to utilize the Linux kernel's perf subsystem which provides sampling information to Nsight Systems.

There are three ways to enable the **`perf_event_open`** syscall. You can enable it by using the **`--privileged=true`** switch, adding **`--cap-add=SYS_ADMIN`** switch to your docker run command file, or you can enable it by setting the seccomp security profile if your system meets the requirements.

Secure computing mode (seccomp) is a feature of the Linux kernel that can be used to restrict an application's access. This feature is available only if the kernel is enabled with seccomp support. To check for seccomp support:

```
$ grep CONFIG_SECCOMP= /boot/config-$(uname -r)
```

The official Docker documentation says:

```
"Seccomp profiles require seccomp 2.2.1 which is not available on Ubuntu 14.04,
 Debian Wheezy, or Debian Jessie. To use seccomp on these distributions, you
 must download the latest static Linux binaries (rather than packages)."
```

Download the default seccomp profile file, default.json, relevant to your Docker version. If **`perf_event_open`** is already listed in the file as guarded by **`CAP_SYS_ADMIN`**, then remove the **`perf_event_open`** line. Add the following lines under "syscalls" and save the resulting file as **`default_with_perf.json`**.

```
{
    "name": "perf_event_open",
    "action": "SCMP_ACT_ALLOW",
    "args": []
},
```

Then you will be able to use the following switch when starting the Docker to apply the new seccomp profile.

```
--security-opt seccomp=default_with_perf.json
```

Launch Docker Collection

Here is an example command that has been used to launch a Docker for testing with Nsight Systems:

```
sudo nvidia-docker run --network=host --security-opt
 seccomp=default_with_perf.json --rm -ti caffe-demo2 bash
```

There is a known issue where Docker collections terminate prematurely with older versions of the driver and the CUDA Toolkit. If collection is ending unexpectedly, please update to the latest versions.

After the Docker has been started, use the Nsight Systems CLI to launch a collection within the Docker. The resulting .qdstrm file can be imported into the Nsight Systems host like any other CLI result.

GUI VNC container

Nsight Systems provides a build script to build a self isolated Docker container with the Nsight Systems GUI and VNC server.

You can find the build.py script in the **`host-linux-x64/Scripts/VncContainer`** directory (or similar on other architectures) under your Nsight Systems installation directory. You will need to have Docker, and Python 3.5 or later.

Available Parameters

Short Name	Full Name	Description
	--vnc-password	(optional) Default password for VNC access (at least 6 characters). If it is specified and empty - will be asked during the build. Can be changed when running a container.
-aba	--additional-build-arguments	(optional) Additional arguments, which will be passed to the "docker build" command.
-hd	--nsys-host-directory	(optional) The directory with Nsight Systems host binaries (with GUI).
-td	--nsys-target-directory	(optional, repeatable) The directory with Nsight Systems target binaries

Short Name	Full Name	Description
		(can be specified multiple times).
	--tigervnc	(optional) Use TigerVNC instead of x11vnc.
	--http	(optional) Install noVNC in the Docker container for HTTP access.
	--rdp	(optional) Install xRDP in the Docker for RDP access.
	--geometry	(optional) Default VNC server resolution in the format WidthxHeight (default 1920x1080).
	--build-directory	(optional) The directory to save temporary files (with the write access for the current user). By default, script or tmp directory will be used.

Ports

These ports can be published from the container to provide access to the Docker container:

Port	Purpose	Condition
TCP 5900	Port for VNC access	
TCP 80 (optional)	Port for HTTP access to noVNC server	Container is build with "--http" parameter
TCP 3389 (optional)	Port for RDP access	Container is build with "--rdp" parameter

Volumes

Docker folder	Purpose	Description
/mnt/host	Root path for shared folders	Folder owned by the Docker user (inner content can be accessed from Nsight Systems GUI)
/mnt/host/Projects		Folder with projects and reports, created by Nsight Systems UI in container

Docker folder	Purpose	Description
/mnt/host/logs	Folder with inner services logs	May be useful to send reports to developers

Environment variables

Variable Name	Purpose
VNC_PASSWORD	Password for VNC access (at least 6 characters)
NSYS_WINDOW_WIDTH	Width of VNC server display (in pixels)
NSYS_WINDOW_HEIGHT	Height of VNC server display (in pixels)

Examples

With VNC access on port 5916:

```
sudo docker run -p 5916:5900/tcp -ti nsys-ui-vnc:1.0
```

With VNC access on port 5916 and HTTP access on port 8080:

```
sudo docker run -p 5916:5900/tcp -p 8080:80/tcp -ti nsys-ui-vnc:1.0
```

With VNC access on port 5916, HTTP access on port 8080 and RDP access on port 33890:

```
sudo docker run -p 5916:5900/tcp -p 8080:80/tcp -p 33890:3389/tcp -ti nsys-ui-
vnc:1.0
```

With VNC access on port 5916, shared "HOME" folder from the host, VNC server resolution 3840x2160, and custom VNC password

```
sudo docker run -p 5916:5900/tcp -v $HOME:/mnt/host/home -e
 NSYS_WINDOW_WIDTH=3840 -e NSYS_WINDOW_HEIGHT=2160 -e VNC_PASSWORD=7654321 -ti
 nsys-ui-vnc:1.0
```

With VNC access on port 5916, shared "HOME" folder from the host, and the projects folder to access reports created by Nsight Systems GUI in container

```
sudo docker run -p 5916:5900/tcp -v $HOME:/mnt/host/home -v /opt/NsysProjects:/
mnt/host/Projects -ti nsys-ui-vnc:1.0
```

Chapter 7. DIRECT3D TRACE

Nsight Systems has the ability to trace both the Direct3D 11 API and the Direct3D 12 API on Windows targets.

7.1. D3D11 API trace

Nsight Systems can capture information about Direct3D 11 API calls made by the profiled process. This includes capturing the execution time of D3D11 API functions, performance markers, and frame durations.

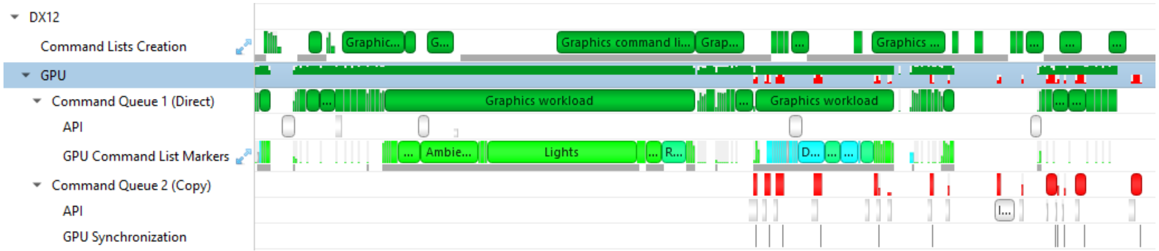
SLI Trace

Trace SLI queries and peer-to-peer transfers of D3D11 applications. Requires SLI hardware and an active SLI profile definition in the NVIDIA console.

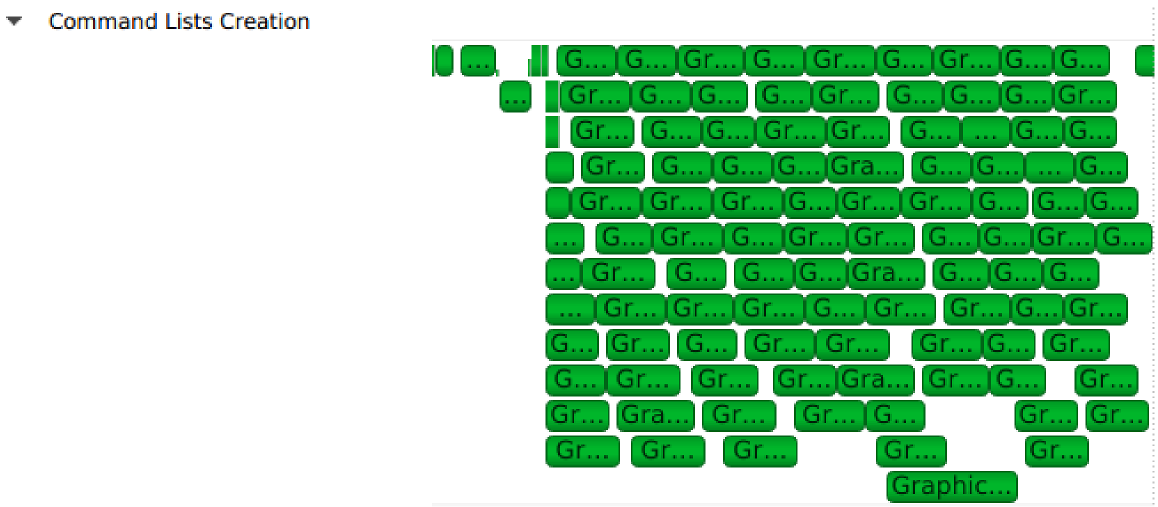
7.2. D3D12 API Trace

Direct3D 12 is a low-overhead 3D graphics and compute API for Microsoft Windows. Information about Direct3D 12 can be found at the Direct3D 12 Programming Guide.

Nsight Systems can capture information about Direct3D 12 usage by the profiled process. This includes capturing the execution time of D3D12 API functions, corresponding workloads executed on the GPU, performance markers, and frame durations.

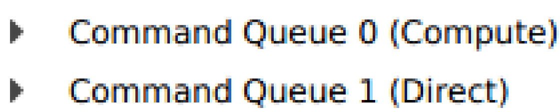


The Command List Creation row displays time periods when command lists were being created. This enables developers to improve their application's multi-threaded command list creation. Command list creation time period is measured between the call to **`ID3D12GraphicsCommandList::Reset`** and the call to **`ID3D12GraphicsCommandList::Close`**.



The GPU row shows a compressed view of the D3D12 queue activity, color-coded by the queue type. Expanding it will show the individual queues and their corresponding API calls.

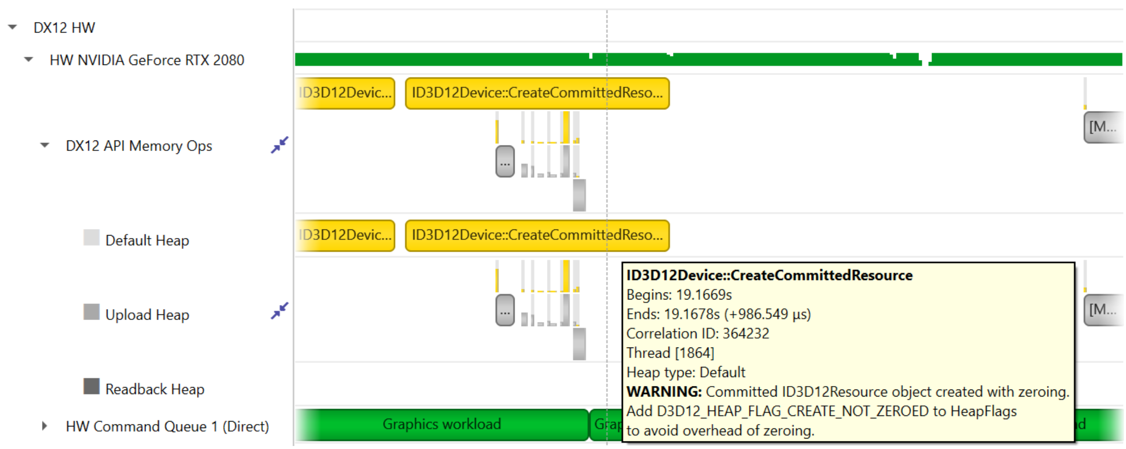
A Command Queue row is displayed for each D3D12 command queue created by the profiled application. The row's header displays the queue's running index and its type (Direct, Compute, Copy).



The DX12 API Memory Ops row displays all API memory operations and non-persistent resource mappings. Event ranges in the row are color-coded by the heap type they belong to (Default, Readback, Upload, Custom, or CPU-Visible VRAM), with usage warnings highlighted in yellow. A breakdown of the operations can be found by expanding the row to show rows for each individual heap type.

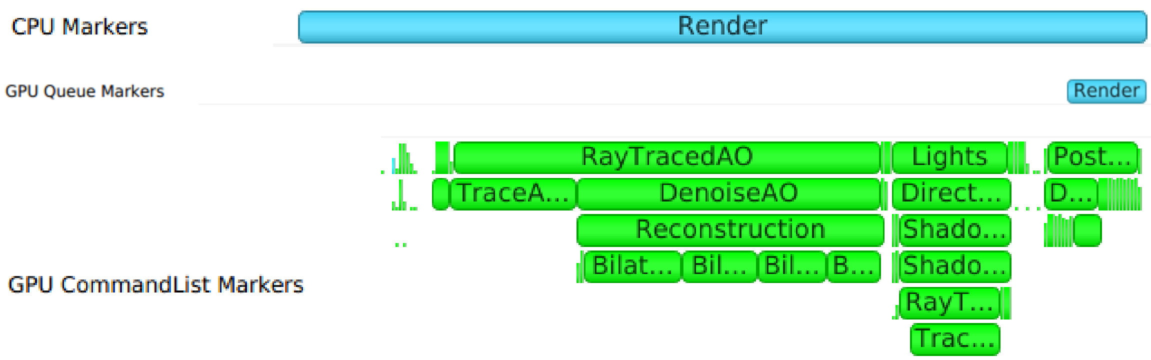
The following operations and warnings are shown:

- Calls to **ID3D12Device::CreateCommittedResource**, **ID3D12Device4::CreateCommittedResource1**, and **ID3D12Device8::CreateCommittedResource2**
  - A warning will be reported if **D3D12_HEAP_FLAG_CREATE_NOT_ZEROED** is not set in the method's **HeapFlags** parameter
- Calls to **ID3D12Device::CreateHeap** and **ID3D12Device4::CreateHeap1**
  - A warning will be reported if **D3D12_HEAP_FLAG_CREATE_NOT_ZEROED** is not set in the **Flags** field of the method's **pDesc** parameter
- Calls to **ID3D12Resource::ReadFromSubResource**
  - A warning will be reported if the read is to a **D3D12_CPU_PAGE_PROPERTY_WRITE_COMBINE** CPU page or from a **D3D12_HEAP_TYPE_UPLOAD** resource
- Calls to **ID3D12Resource::WriteToSubResource**
  - A warning will be reported if the write is from a **D3D12_CPU_PAGE_PROPERTY_WRITE_BACK** CPU page or to a **D3D12_HEAP_TYPE_READBACK** resource
- Calls to **ID3D12Resource::Map** and **ID3D12Resource::Unmap** will be matched into [Map, Unmap] ranges for non-persistent mappings. If a mapping range is nested, only the most external range (reference count = 1) will be shown.

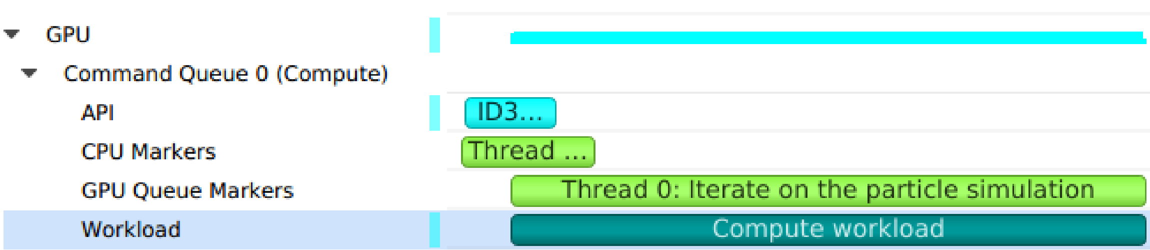


The API row displays time periods where **ID3D12CommandQueue::ExecuteCommandLists** was called. The GPU Workload row displays time periods where workloads were executed by the GPU. The workload's type (Graphics, Compute, Copy, etc.) is displayed on the bar representing the workload's GPU execution.

In addition, you can see the PIX command queue CPU-side performance markers, GPU-side performance markers and the GPU Command List performance markers, each in their row.



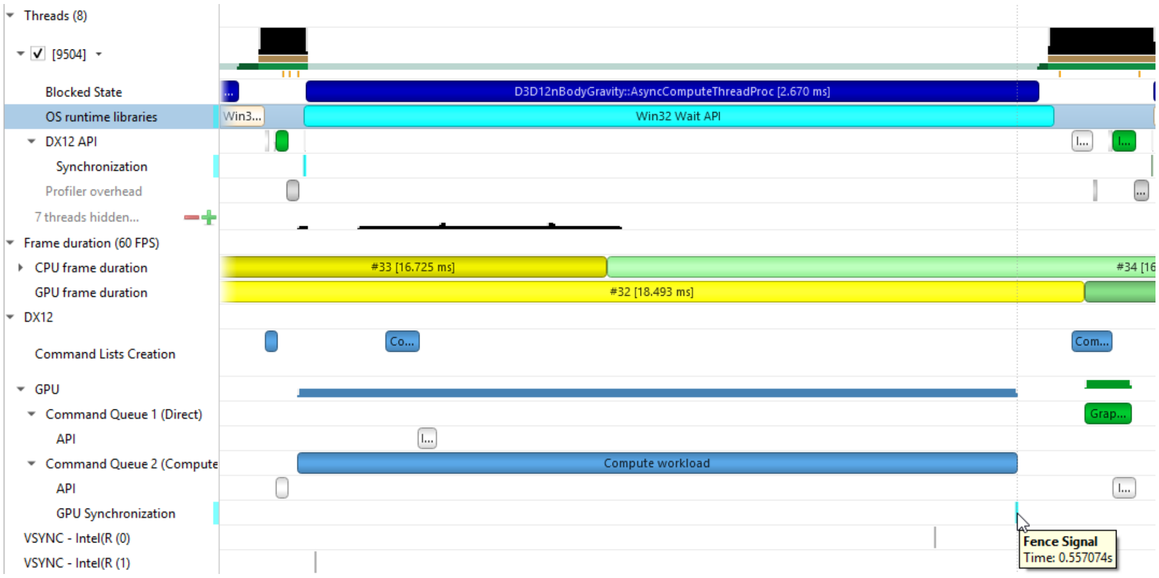
Clicking on a GPU workload highlights the corresponding **`ID3D12CommandQueue::ExecuteCommandLists`**, **`ID3D12GraphicsCommandList::Reset`** and **`ID3D12GraphicsCommandList::Close`** **`API`** calls, and vice versa.



Detecting which CPU thread was blocked by a fence can be difficult in complex apps that run tens of CPU threads. The timeline view displays the 3 operations involved:

- The CPU thread pushing a signal command and fence value into the command queue. This is displayed on the DX12 Synchronization sub-row of the calling thread.
- The GPU executing that command, setting the fence value and signaling the fence. This is displayed on the GPU Queue Synchronization sub-row.
- The CPU thread calling a Win32 wait API to block-wait until the fence is signaled. This is displayed on the Thread's OS runtime libraries row.

Clicking one of these will highlight it and the corresponding other two calls.

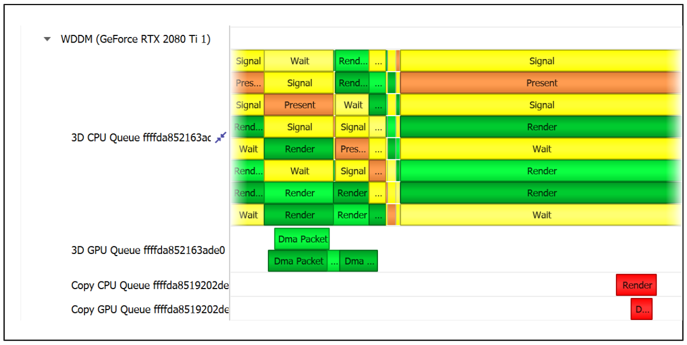

Threads (8)
[9504]
Blocked State
OS runtime libraries
DX12 API
Synchronization
Profiler overhead
7 threads hidden...
Frame duration (60 FPS)
CPU frame duration
GPU frame duration
DX12
Command Lists Creation
GPU
Command Queue 1 (Direct)
API
Command Queue 2 (Compute
API
GPU Synchronization
VSYNC - Intel(R (0)
VSYNC - Intel(R (1)
D3D12nBodyGravity::AsyncComputeThreadProc [2.670 ms]
Win3...
Win32 Wait API
#33 [16.725 ms]
#32 [18.493 ms]
Co...
Com...
Grap...
Compute workload
Fence Signal
Time: 0.557074s

Chapter 8. WDDM QUEUES

The Windows Display Driver Model (WDDM) architecture uses queues to send work packets from the CPU to the GPU. Each D3D device in each process is associated with one or more contexts. Graphics, compute, and copy commands that the profiled application uses are associated with a context, batched in a command buffer, and pushed into the relevant queue associated with that context.

Nsight Systems can capture the state of these queues during the trace session.

Enabling the "Collect additional range of ETW events" option will also capture extended DxgKrnl events from the **`Microsoft-Windows-DxgKrnl`** provider, such as context status, allocations, sync wait, signal events, etc.



A command buffer in a WDDM queues may have one the following types:

- Render
- Deferred
- System
- MMIOFlip
- Wait
- Signal
- Device
- Software

It may also be marked as a Present buffer, indicating that the application has finished rendering and requests to display the source surface.

See the Microsoft documentation for the WDDM architecture and the DXGKETW_QUEUE_PACKET_TYPE enumeration.

To retain the .etl trace files captured, so that they can be viewed in other tools (e.g. GPUView), change the "Save ETW log files in project folder" option under "Profile Behavior" in Nsight Systems's global Options dialog. The .etl files will appear in the same folder as the .nsys-rep file, accessible by right-clicking the report in the Project Explorer and choosing "Show in Folder...". Data collected from each ETW provider will appear in its own .etl file, and an additional .etl file named "Report XX-Merged-*.etl", containing the events from all captured sources, will be created as well.

Chapter 9. WDDM HW SCHEDULER

When GPU Hardware Scheduling is enabled in Windows 10 or newer version, the Windows Display Driver Model (WDDM) uses the DxgKrnl ETW provider to expose report of NVIDIA GPUs' hardware scheduling context switches.

Nsight Systems can capture these context switch events, and display under the GPUs in the timeline rows titled WDDM HW Scheduler - [HW Queue type]. The ranges under each queue will show the process name and PID assoicated with the GPU work during the time period.

The events will be captured if GPU Hardware Scheduling is enabled in the Windows System Display settings, and "Collect WDDM Trace" is enabled in the Nsight Systems Project Settings.

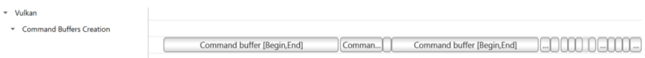
Chapter 10. VULKAN API TRACE

10.1. Vulkan Overview

Vulkan is a low-overhead, cross-platform 3D graphics and compute API, targeting a wide variety of devices from PCs to mobile phones and embedded platforms. The Vulkan API is defined by the Khronos Group. Information about Vulkan and the Khronos Group can be found at the Khronos Vulkan Site.

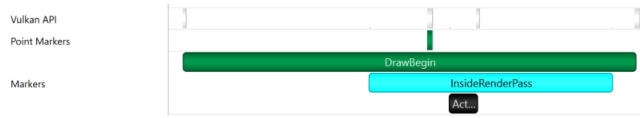
Nsight Systems can capture information about Vulkan usage by the profiled process. This includes capturing the execution time of Vulkan API functions, corresponding GPU workloads, debug util labels, and frame durations. Vulkan profiling is supported on both Windows and x86 Linux operating systems.

The Command Buffer Creation row displays time periods when command buffers were being created. This enables developers to improve their application's multi-threaded command buffer creation. Command buffer creation time period is measured between the call to **`vkBeginCommandBuffer`** and the call to **`vkEndCommandBuffer`**.



A Queue row is displayed for each Vulkan queue created by the profiled application. The API sub-row displays time periods where **vkQueueSubmit** was called. The GPU Workload sub-row displays time periods where workloads were executed by the GPU.

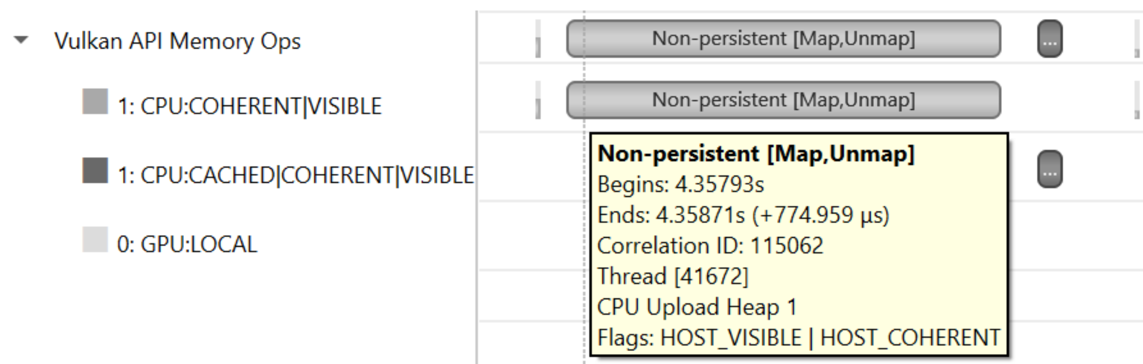
In addition, you can see Vulkan debug util labels on both the CPU and the GPU.

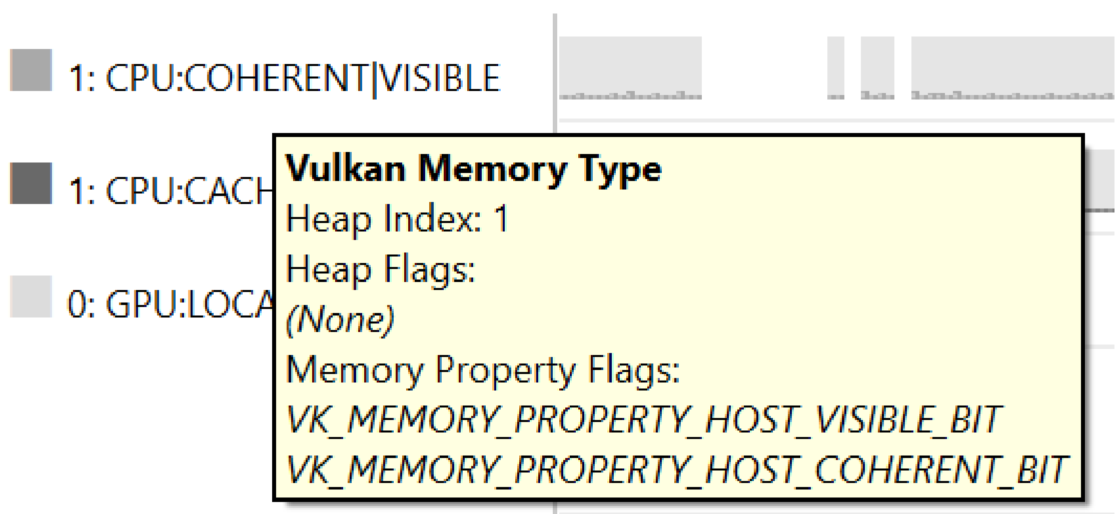


Clicking on a GPU workload highlights the corresponding **vkQueueSubmit** call, and vice versa.

The Vulkan Memory Operations row contains an aggregation of all the Vulkan host-side memory operations, such as host-blocking writes and reads or non-persistent map-unmap ranges.

The row is separated into sub-rows by heap index and memory type - the tooltip for each row and the ranges inside show the heap flags and the memory property flags.



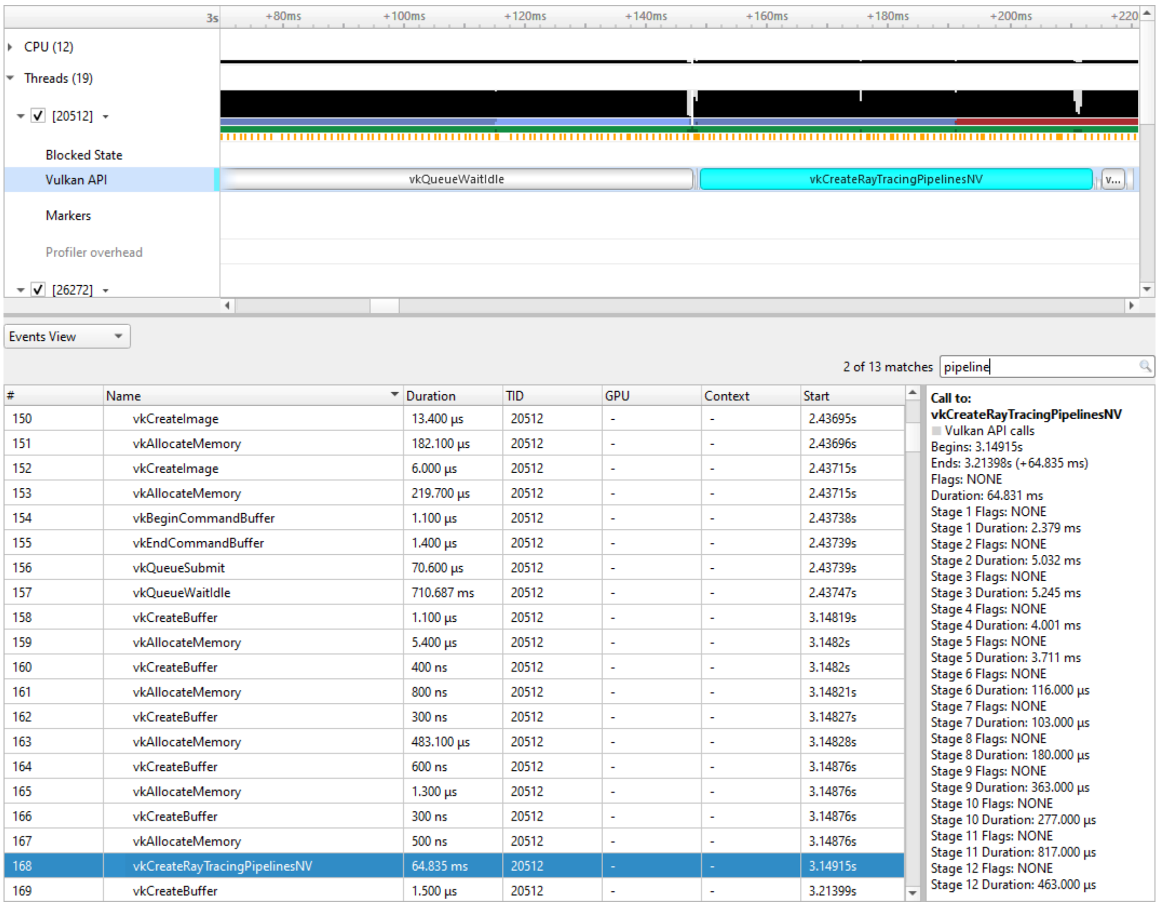


10.2. Pipeline Creation Feedback

When tracing target application calls to Vulkan pipeline creation APIs, Nsight Systems leverages the Pipeline Creation Feedback extension to collect more details about the duration of individual pipeline creation stages.

See Pipeline Creation Feedback extension for details about this extension.

Vulkan pipeline creation feedback is available on NVIDIA driver release 435 or later.



10.3. Vulkan GPU Trace Notes

- Vulkan GPU trace is available only when tracing apps that use NVIDIA GPUs.
- The endings of Vulkan Command Buffers execution ranges on Compute and Transfer queues may appear earlier on the timeline than their actual occurrence.

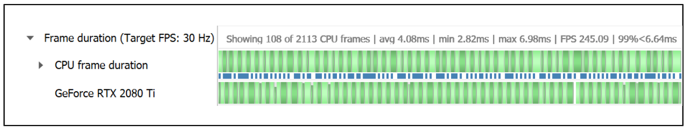
Chapter 11. STUTTER ANALYSIS

Stutter Analysis Overview

Nsight Systems on Windows targets displays stutter analysis visualization aids for profiled graphics applications that use either OpenGL, D3D11, D3D12 or Vulkan, as detailed below in the following sections.

11.1. FPS Overview

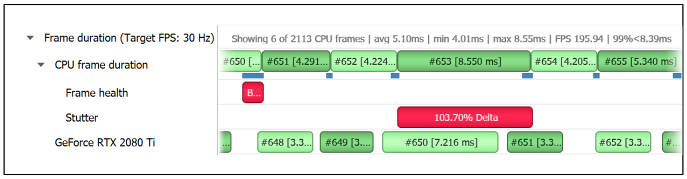
The Frame Duration section displays frame durations on both the CPU and the GPU.



The frame duration row displays live FPS statistics for the current timeline viewport. Values shown are:

1. Number of CPU frames shown of the total number captured
2. Average, minimal, and maximal CPU frame time of the currently displayed time range
3. Average FPS value for the currently displayed frames
4. The 99th percentile value of the frame lengths (such that only 1% of the frames in the range are longer than this value).

The values will update automatically when scrolling, zooming or filtering the timeline view.



The stutter row highlights frames that are significantly longer than the other frames in their immediate vicinity.

The stutter row uses an algorithm that compares the duration of each frame to the median duration of the surrounding 19 frames. Duration difference under 4 milliseconds is never considered a stutter, to avoid cluttering the display with frames whose absolute stutter is small and not noticeable to the user.

For example, if the stutter threshold is set at 20%:

1. Median duration is 10 ms. Frame with 13 ms time will not be reported (relative difference > 20%, absolute difference < 4 ms)
2. Median duration is 60 ms. Frame with 71 ms time will not be reported (relative difference < 20%, absolute difference > 4 ms)
3. Median duration is 60 ms. Frame with 80 ms is a stutter (relative difference > 20%, absolute difference > 4 ms, both conditions met)

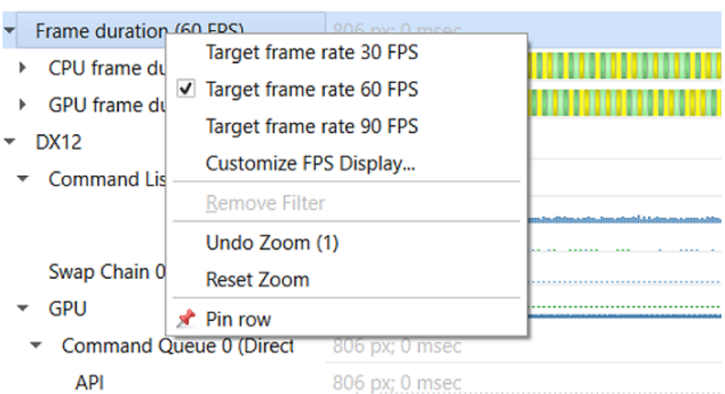
OSC detection

The "19 frame window median" algorithm by itself may not work well with some cases of "oscillation" (consecutive fast and slow frames), resulting in some false positives. The median duration is not meaningful in cases of oscillation and can be misleading.

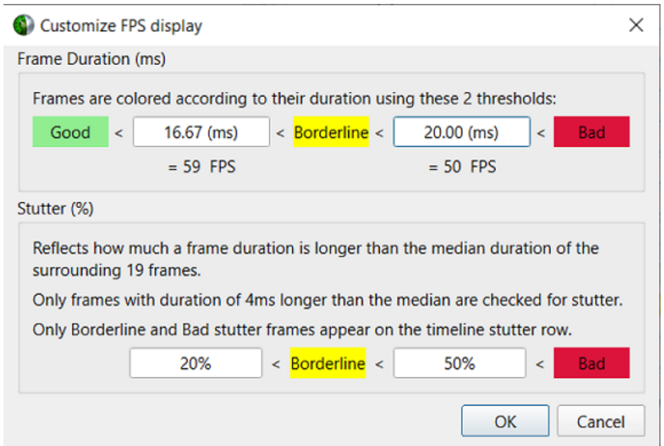
To address the issue and identify if oscillating frames, the following method is applied:

1. For every frame, calculate the median duration, 1st and 3rd quartiles of 19-frames window.
2. Calculate the delta and ratio between 1st and 3rd quartiles.
3. If the 90th percentile of 3rd – 1st quartile delta array > 4 ms AND the 90th percentile of 3rd/1st quartile array > 1.2 (120%) then mark the results with "OSC" text.

Right-clicking the Frame Duration row caption lets you choose the target frame rate (30, 60, 90 or custom frames per second).



By clicking the Customize FPS Display option, a customization dialog pops up. In the dialog, you can now define the frame duration threshold to customize the view of the potentially problematic frames. In addition, you can define the threshold for the stutter analysis frames.



Frame duration bars are color coded:

- Green, the frame duration is shorter than required by the target FPS ratio.
- Yellow, duration is slightly longer than required by the target FPS rate.
- Red, duration far exceeds that required to maintain the target FPS rate.

The CPU Frame Duration row displays the CPU frame duration measured between the ends of consecutive frame boundary calls:

- The OpenGL frame boundaries are **`eglSwapBuffers/glXSwapBuffers/SwapBuffers`** calls.
- The D3D11 and D3D12 frame boundaries are **`IDXGISwapChainX::Present`** calls.
- The Vulkan frame boundaries are **`vkQueuePresentKHR`** calls.

The timing of the actual calls to the frame boundary calls can be seen in the blue bar at the bottom of the CPU frame duration row

The GPU Frame Duration row displays the time measured between

- The start time of the first GPU workload execution of this frame.
- The start time of the first GPU workload execution of the next frame.

Reflex SDK

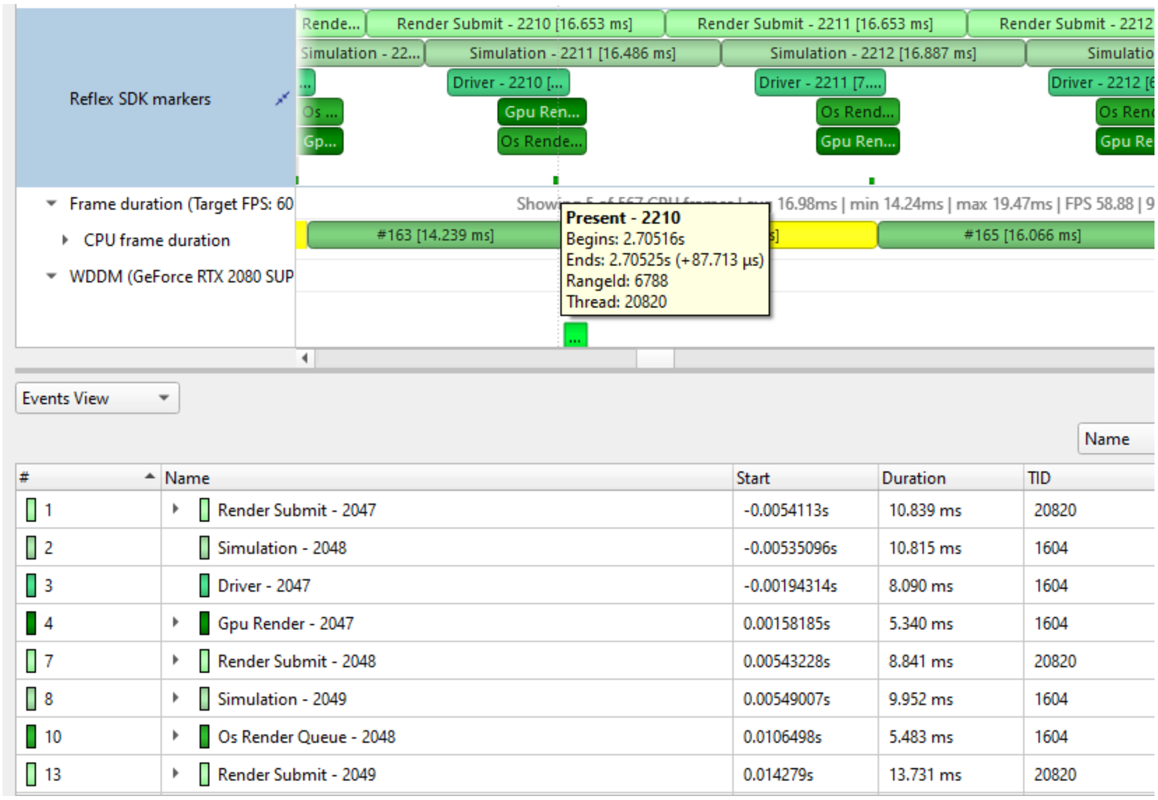
NVIDIA Reflex SDK is a series of NVAPI calls that allow applications to integrate the Ultra Low Latency driver feature more directly into their game to further optimize synchronization between simulation and rendering stages and lower the latency between user input and final image rendering. For more details about Reflex SDK, see Reflex SDK Site.

Nsight Systems will automatically capture NVAPI functions when either Direct3D 11, Direct3D 12, or Vulkan API trace are enabled.

The Reflex SDK row displays timeline ranges for the following types of latency markers:

- RenderSubmit.
- Simulation.
- Present.

- Driver.
- OS Render Queue.
- GPU Render.



Performance Warnings row

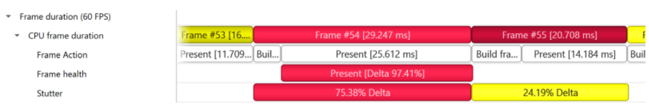
This row shows performance warnings and common pitfalls that are automatically detected based on the enabled capture types. Warnings are reported for:

- ETW performance warnings
- Vulkan calls to **`vkQueueSubmit`** and D3D12 calls to **`ID3D12CommandQueue::ExecuteCommandList`** that take a longer time to execute than the total time of the GPU workloads they generated
- D3D12 Memory Operation warnings
- Usage of Vulkan API functions that may adversely affect performance
- Creation of a Vulkan device with memory zeroing, whether by physical device default or manually
- Vulkan command buffer barrier which can be combined or removed, such as subsequent barriers or read-to-read barriers

11.2. Frame Health

The Frame Health row displays actions that took significantly a longer time during the current frame, compared to the median time of the same actions executed during the surrounding 19-frames. This is a great tool for detecting the reason for frame time stuttering. Such actions may be: shader compilation, present, memory mapping, and more. Nsight Systems measures the accumulated time of such actions in each frame. For example: calculating the accumulated time of shader compilations in each frame and comparing it to the accumulated time of shader compilations in the surrounding 19 frames.

Example of a Vulkan frame health row:



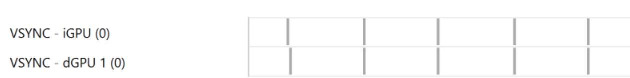
11.3. GPU Memory Utilization

The Memory Utilization row displays the amount of used local GPU memory and the commit limit for each GPU.

Note that this is not the same as the CUDA kernel memory allocation graph, see CUDA GPU Memory Graph for that functionality.

11.4. Vertical Synchronization

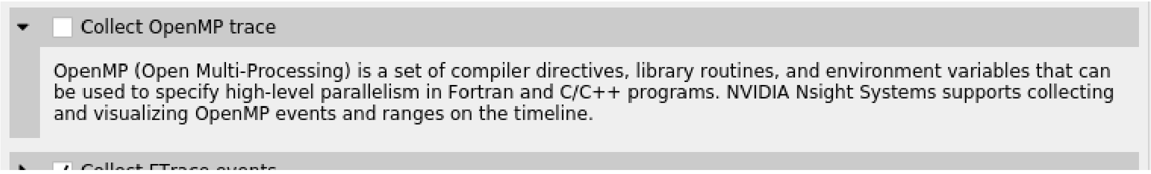
The VSYNC rows display when the monitor's vertical synchronizations occur.



Chapter 12. OPENMP TRACE

Nsight Systems for Linux is capable of capturing information about OpenMP events. This functionality is built on the OpenMP Tools Interface (OMPT), full support is available only for runtime libraries supporting tools interface defined in OpenMP 5.0 or greater.

As an example, LLVM OpenMP runtime library partially implements tools interface. If you use PGI compiler <= 20.4 to build your OpenMP applications, add -mp=libomp switch to use LLVM OpenMP runtime and enable OMPT based tracing. If you use Clang, make sure the LLVM OpenMP runtime library you link to was compiled with tools interface enabled.



Only a subset of the OMPT callbacks are processed:

```
ompt_callback_parallel_begin
ompt_callback_parallel_end
ompt_callback_sync_region
ompt_callback_task_create
ompt_callback_task_schedule
ompt_callback_implicit_task
ompt_callback_master
ompt_callback_reduction
ompt_callback_task_create
ompt_callback_cancel
ompt_callback_mutex_acquire, ompt_callback_mutex_acquired
ompt_callback_mutex_acquired, ompt_callback_mutex_released
ompt_callback_mutex_released
ompt_callback_work
ompt_callback_dispatch
ompt_callback_flush
```

Note: The raw OMPT events are

used to generate ranges indicating the runtime of OpenMP operations and constructs.

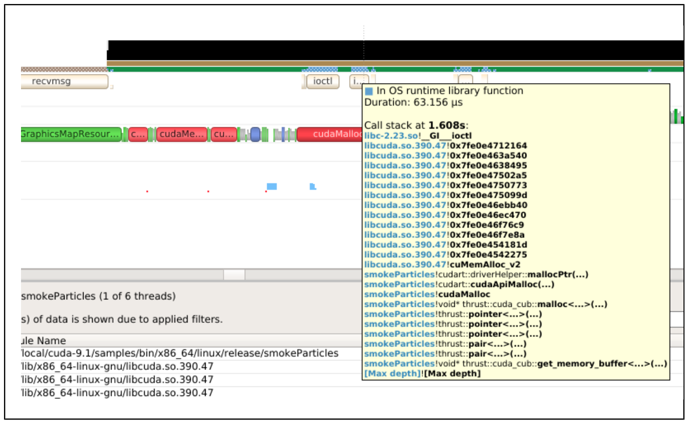
Example screenshot:

Chapter 13. OS RUNTIME LIBRARIES TRACE

On Linux, OS runtime libraries can be traced to gather information about low-level userspace APIs. This traces the system call wrappers and thread synchronization interfaces exposed by the C runtime and POSIX Threads (pthread) libraries. This does not perform a complete runtime library API trace, but instead focuses on the functions that can take a long time to execute, or could potentially cause your thread be unscheduled from the CPU while waiting for an event to complete. OS runtime trace is not available for Windows targets.

OS runtime tracing complements and enhances sampling information by:

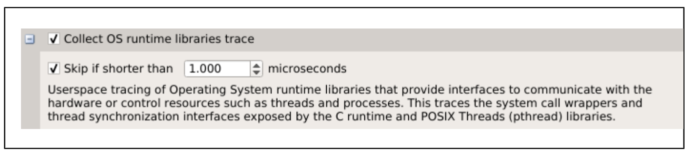
1. Visualizing when the process is communicating with the hardware, controlling resources, performing multi-threading synchronization or interacting with the kernel scheduler.
2. Adding additional thread states by correlating how OS runtime libraries traces affect the thread scheduling:
    - **Waiting** — the thread is not scheduled on a CPU, it is inside of an OS runtime libraries trace and is believed to be waiting on the firmware to complete a request.
    - **In OS runtime library function** — the thread is scheduled on a CPU and inside of an OS runtime libraries trace. If the trace represents a system call, the process is likely running in kernel mode.
3. Collecting backtraces for long OS runtime libraries call. This provides a way to gather blocked-state backtraces, allowing you to gain more context about why the thread was blocked so long, yet avoiding unnecessary overhead for short events.



To enable OS runtime libraries tracing from Nsight Systems:

CLI — Use the **`-t`**, **`--trace`** option with the **`osrt`** parameter. See Command Line Options for more information.

GUI — Select the **Collect OS runtime libraries trace** checkbox.



You can also use **Skip if shorter than**. This will skip calls shorter than the given threshold. Enabling this option will improve performances as well as reduce noise on the timeline. We strongly encourage you to skip OS runtime libraries call shorter than 1 μs.

13.1. Locking a Resource

The functions listed below receive a special treatment. If the tool detects that the resource is already acquired by another thread and will induce a blocking call, we always trace it. Otherwise, it will never be traced.

```
pthread_mutex_lock
pthread_rwlock_rdlock
pthread_rwlock_wrlock
pthread_spin_lock
sem_wait
```

Note that even if a call is determined as potentially blocking, there is a chance that it may not actually block after a few cycles have elapsed. The call will still be traced in this scenario.

13.2. Limitations

- Nsight Systems only traces syscall wrappers exposed by the C runtime. It is not able to trace syscall invoked through assembly code.

- Additional thread states, as well as backtrace collection on long calls, are only enabled if sampling is turned on.
- It is not possible to configure the depth and duration threshold when collecting backtraces. Currently, only OS runtime libraries calls longer than 80 μs will generate a backtrace with a maximum of 24 frames. This limitation will be removed in a future version of the product.
- It is required to compile your application and libraries with the **`-funwind-tables`** compiler flag in order for Nsight Systems to unwind the backtraces correctly.

13.3. OS Runtime Libraries Trace Filters

The OS runtime libraries tracing is limited to a select list of functions. It also depends on the version of the C runtime linked to the application.

13.4. OS Runtime Default Function List

Libc system call wrappers

```
accept
accept4
acct
alarm
arch_prctl
bind
bpf
brk
chroot
clock_nanosleep
connect
copy_file_range
creat
creat64
dup
dup2
dup3
epoll_ctl
epoll_pwait
epoll_wait
fallocate
fallocate64
fcntl
fdatasync
flock
fork
fsync
ftruncate
futex
ioctl
ioperm
iopl
kill
killpg
listen
membarrier
mlock
mlock2
mlockall
mmap
mmap64
mount
move_pages
mprotect
mq_notify
mq_open
mq_receive
mq_send
mq_timedreceive
mq_timedsend
mremap
msgctl
msgget
msgrcv
msgsnd
msync
munmap
nanosleep
nfsservctl
open
open64
openat
openat64
pause
pipe
pipe2
pivot_root
poll
```

POSIX Threads

```
pthread_barrier_wait
pthread_cancel
pthread_cond_broadcast
pthread_cond_signal
pthread_cond_timedwait
pthread_cond_wait
pthread_create
pthread_join
pthread_kill
pthread_mutex_lock
pthread_mutex_timedlock
pthread_mutex_trylock
pthread_rwlock_rdlock
pthread_rwlock_timedrdlock
pthread_rwlock_timedwrlock
pthread_rwlock_tryrdlock
pthread_rwlock_trywrlock
pthread_rwlock_wrlock
pthread_spin_lock
pthread_spin_trylock
pthread_timedjoin_np
pthread_tryjoin_np
pthread_yield
sem_timedwait
sem_trywait
sem_wait
```

I/O

```
aio_fsync
aio_fsync64
aio_suspend
aio_suspend64
fclose
fcloseall
fflush
fflush_unlocked
fgetc
fgetc_unlocked
fgets
fgets_unlocked
fgetwc
fgetwc_unlocked
fgetws
fgetws_unlocked
flockfile
fopen
fopen64
fputc
fputc_unlocked
fputs
fputs_unlocked
fputwc
fputwc_unlocked
fputws
fputws_unlocked
fread
fread_unlocked
freopen
freopen64
ftrylockfile
fwrite
fwrite_unlocked
getc
getc_unlocked
getdelim
getline
getw
getwc
getwc_unlocked
lockf
lockf64
mkfifo
mkfifoat
posix_fallocate
posix_fallocate64
putc
putc_unlocked
putwc
putwc_unlocked
```

Miscellaneous

```
forkpty
popen
posix_spawn
posix_spawnp
sigwait
sigwaitinfo
sleep
system
usleep
```

Chapter 14. NVTX TRACE

The NVIDIA Tools Extension Library (NVTX) is a powerful mechanism that allows users to manually instrument their application. Nsight Systems can then collect the information and present it on the timeline.

Nsight Systems supports version 3.0 of the NVTX specification.

The following features are supported:

- Domains

  `nvtxDomainCreate(), nvtxDomainDestroy()`

  `nvtxDomainRegisterString()`
- Push-pop ranges (nested ranges that start and end in the same thread).

  `nvtxRangePush(), nvtxRangePushEx()`

  `nvtxRangePop()`

  `nvtxDomainRangePushEx()`

  `nvtxDomainRangePop()`
- Start-end ranges (ranges that are global to the process and are not restricted to a single thread)

  `nvtxRangeStart(), nvtxRangeStartEx()`

  `nvtxRangeEnd()`

  `nvtxDomainRangeStartEx()`

  `nvtxDomainRangeEnd()`
- Marks

  `nvtxMark(), nvtxMarkEx()`

  `nvtxDomainMarkEx()`
- Thread names

  `nvtxNameOsThread()`
- Categories

  `nvtxNameCategory()`

  `nvtxDomainNameCategory()`

To learn more about specific features of NVTX, please refer to the NVTX header file: **`nvToolsExt.h`** or the NVTX documentation.

To use NVTX in your application, follow these steps:

1. Add **`#include "nvtx3/nvToolsExt.h"`** in your source code. The nvtx3 directory is located in the Nsight Systems package in the Target-<architecture>/nvtx/include directory and is available via github at http://github.com/NVIDIA/NVTX.
2. Add the following compiler flag: **`-ldl`**
3. Add calls to the NVTX API functions. For example, try adding **`nvtxRangePush("main")`** in the beginning of the **`main()`** function, and **`nvtxRangePop()`** just before the return statement in the end.

   For convenience in C++ code, consider adding a wrapper that implements RAII (resource acquisition is initialization) pattern, which would guarantee that every range gets closed.
4. In the project settings, select the **Collect NVTX trace** checkbox.

In addition, by enabling the "Insert NVTX Marker hotkey" option it is possible to add NVTX markers to a running non-console applications by pressing the F11 key. These will appear in the report under the NVTX Domain named "HotKey markers".

Typically calls to NVTX functions can be left in the source code even if the application is not being built for profiling purposes, since the overhead is very low when the profiler is not attached.

NVTX is not intended to annotate very small pieces of code that are being called very frequently. A good rule of thumb to use: if code being annotated usually takes less than 1 microsecond to execute, adding an NVTX range around this code should be done carefully.

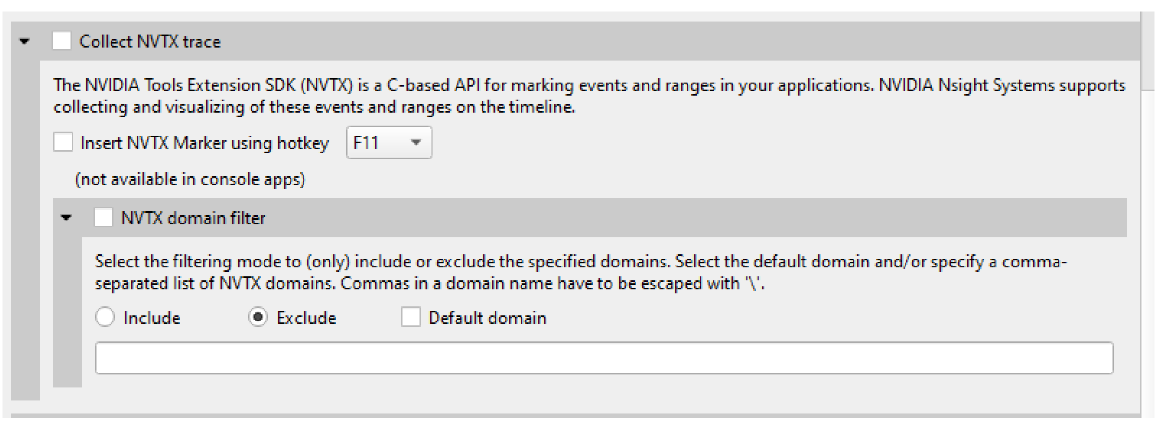
Note:	Range annotations should be matched carefully. If many ranges are opened but not closed, Nsight Systems has no meaningful way to visualize it. A rule of thumb

	is to not have more than a couple dozen ranges open at any point in time. Nsight Systems does not support reports with many unclosed ranges.

NVTX Domains and Categories

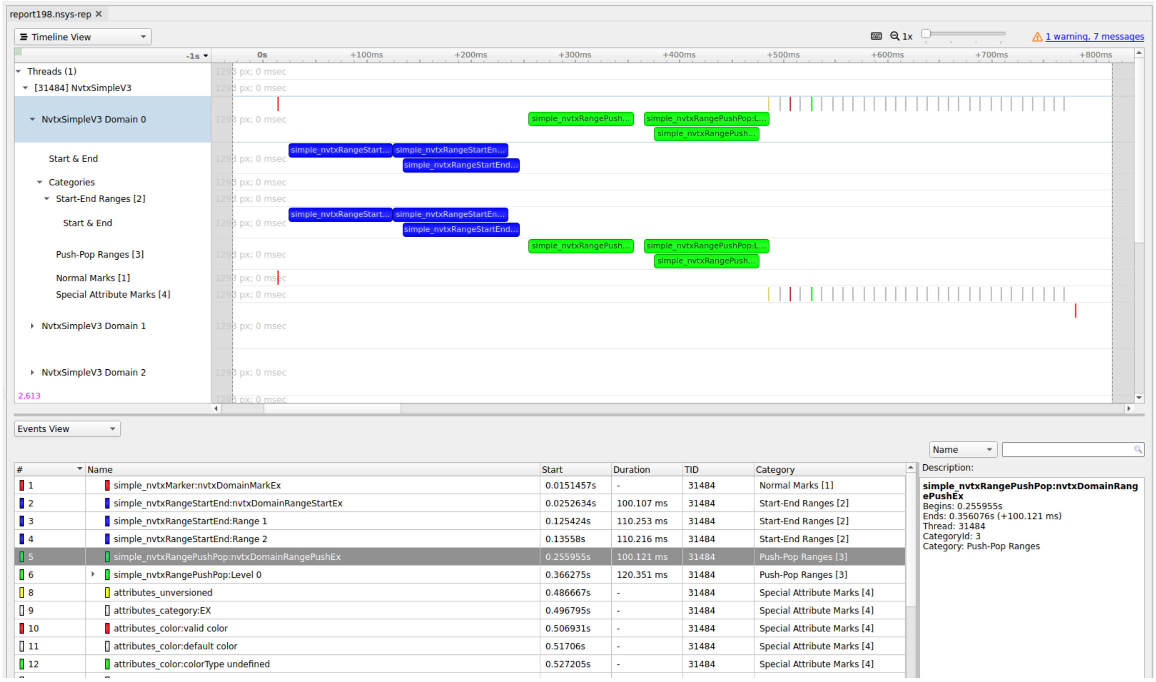
NVTX domains enable scoping of annotations. Unless specified differently, all events and annotations are in the default domain. Additionally, categories can be used to group events.

Nsight Systems gives the user the ability to include or exclude NVTX events from a particular domain. This can be especially useful if you are profiling across multiple libraries and are only interested in nvtx events from some of them.



This functionality is also available from the CLI. See the CLI documentation for **`--nvtx-domain-include`** and **`--nvtx-domain-exclude`** for more details.

Categories that are set in by the user will be recognized and displayed in the GUI.



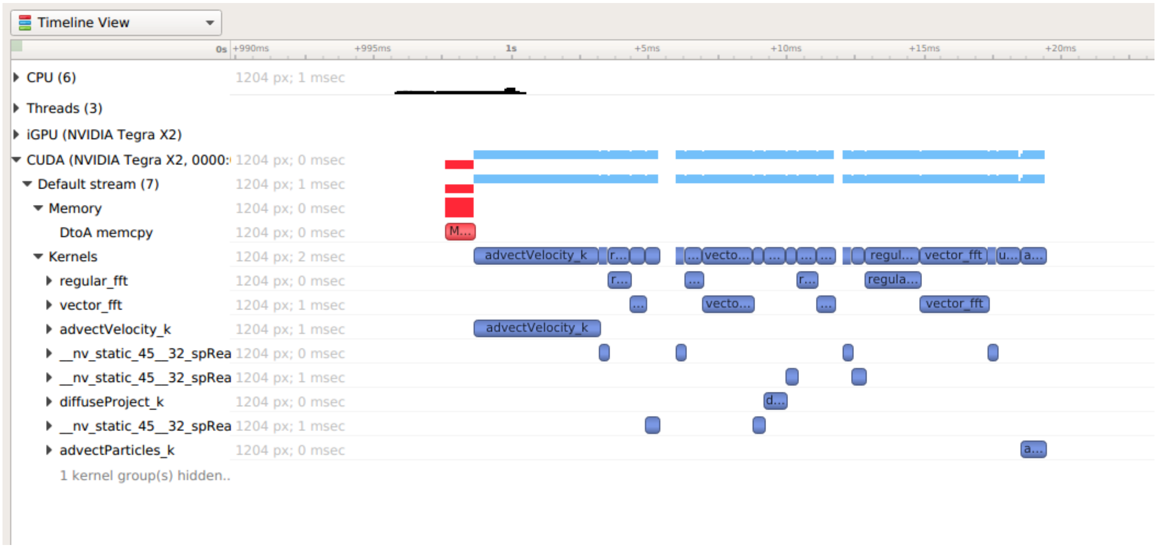
Chapter 15. CUDA TRACE

Nsight Systems is capable of capturing information about CUDA execution in the profiled process.

The following information can be collected and presented on the timeline in the report:

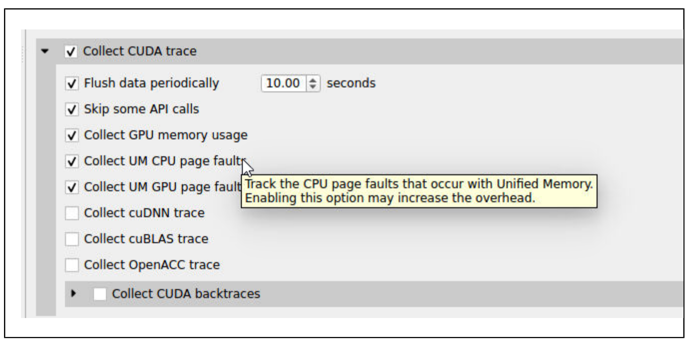
- CUDA API trace — trace of CUDA Runtime and CUDA Driver calls made by the application.
  - CUDA Runtime calls typically start with **`cuda`** prefix (e.g. **`cudaLaunch`**).
  - CUDA Driver calls typically start with **`cu`** prefix (e.g. **`cuDeviceGetCount`**).
- CUDA workload trace — trace of activity happening on the GPU, which includes memory operations (e.g., Host-to-Device memory copies) and kernel executions. Within the threads that use the CUDA API, additional child rows will appear in the timeline tree.
- On Nsight Systems Workstation Edition, cuDNN and cuBLAS API tracing and OpenACC tracing.

Near the bottom of the timeline row tree, the GPU node will appear and contain a CUDA node. Within the CUDA node, each CUDA context used within the process will be shown along with its corresponding CUDA streams. Steams will contain memory operations and kernel launches on the GPU. Kernel launches are represented by blue, while memory transfers are displayed in red.

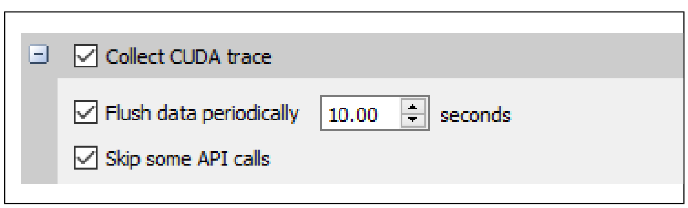


The easiest way to capture CUDA information is to launch the process from Nsight Systems, and it will setup the environment for you. To do so, simply set up a normal launch and select the **Collect CUDA trace** checkbox.

For Nsight Systems Workstation Edition this looks like:



For Nsight Systems Embedded Platforms Edition this looks like:



Additional configuration parameters are available:

- **Collect backtraces for API calls longer than X seconds** - turns on collection of CUDA API backtraces and sets the minimum time a CUDA API event must take before its backtraces are collected. Setting this value too low can cause high application overhead and seriously increase the size of your results file.
- **Flush data periodically** — specifies the period after which an attempt to flush CUDA trace data will be made. Normally, in order to collect full CUDA trace, the application needs to finalize the device used for CUDA work (call

`cudaDeviceReset()`, and then let the application gracefully exit (as opposed to crashing).

This option allows flushing CUDA trace data even before the device is finalized. However, it might introduce additional overhead to a random CUDA Driver or CUDA Runtime API call.

- **Skip some API calls** — avoids tracing insignificant CUDA Runtime API calls (namely, **`cudaConfigureCall()`**, **`cudaSetupArgument()`**, **`cudaHostGetDevicePointers()`**). Not tracing these functions allows Nsight Systems to significantly reduce the profiling overhead, without losing any interesting data. (See CUDA Trace Filters, below)
- **Collect GPU Memory Usage** - collects information used to generate a graph of CUDA allocated memory across time. Note that this will increase overhead. See section on **CUDA GPU Memory Allocation Graph** below.
- **Collect Unified Memory CPU page faults** - collects information on page faults that occur when CPU code tries to access a memory page that resides on the device. See section on **Unified Memory CPU Page Faults** in the **Unified Memory Transfer Trace** documentation below.
- **Collect Unified Memory GPU page faults** - collects information on page faults that occur when GPU code tries to access a memory page that resides on the CPU. See section on **Unified Memory GPU Page Faults** in the **Unified Memory Transfer Trace** documentation below.
- **Collect CUDA Graph trace** - by default, CUDA tracing will collect and expose information on a whole graph basis. The user can opt to collect on a node per node basis. See section on **CUDA Graph Trace** below.
- For Nsight Systems Workstation Edition, **Collect cuDNN trace**, **Collect cuBLAS trace**, **Collect OpenACC trace** - selects which (if any) extra libraries that depend on CUDA to trace.

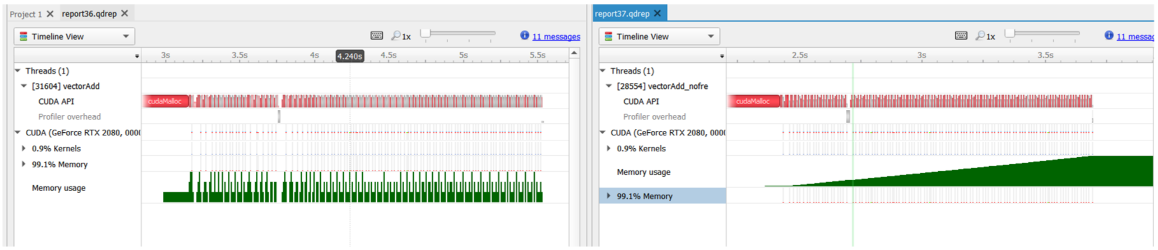
  OpenACC versions 2.0, 2.5, and 2.6 are supported when using PGI runtime version 15.7 or greater and not compiling statically. In order to differentiate constructs, a PGI runtime of 16.1 or later is required. Note that Nsight Systems Workstation Edition does not support the GCC implementation of OpenACC at this time.

Please note that if your application crashes before all collected CUDA trace data has been copied out, some or all data might be lost and not present in the report.

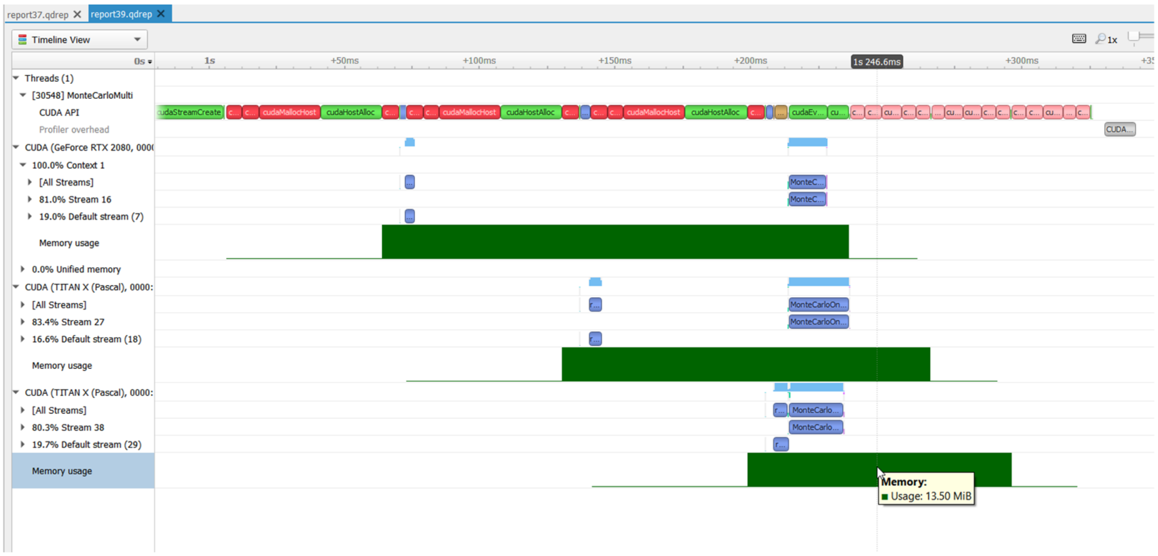
15.1. CUDA GPU Memory Allocation Graph

When the **Collect GPU Memory Usage** option is selected from the **Collect CUDA trace** option set, Nsight Systems will track CUDA GPU memory allocations and deallocations and present a graph of this information in the timeline. This is not the same as the GPU memory graph generated during stutter analysis on the Windows target (see Stutter Memory Trace)

Below, in the report on the left, memory is allocated and freed during the collection. In the report on the right, memory is allocated, but not freed during the collection.

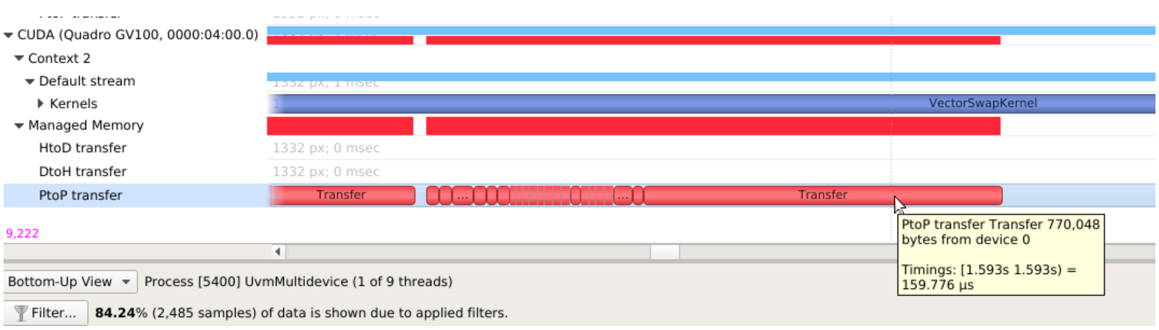


Here is another example, where allocations are happening on multiple GPUs



15.2. Unified Memory Transfer Trace

For Nsight Systems Workstation Edition, Unified Memory (also called Managed Memory) transfer trace is enabled automatically in Nsight Systems when CUDA trace is selected. It incurs no overhead in programs that do not perform any Unified Memory transfers. Data is displayed in the Managed Memory area of the timeline:

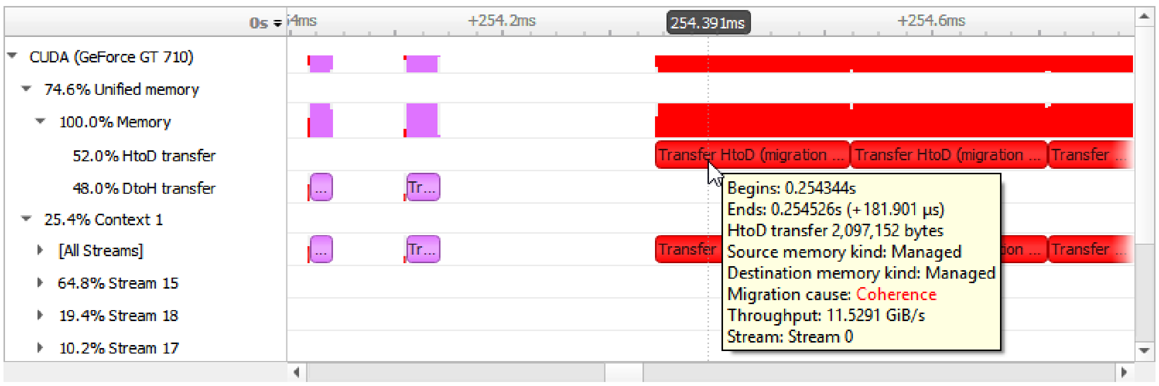


HtoD transfer indicates the CUDA kernel accessed managed memory that was residing on the host, so the kernel execution paused and transferred the data to the device. Heavy traffic here will incur performance penalties in CUDA kernels, so consider using manual cudaMemcpy operations from pinned host memory instead.

PtoP transfer indicates the CUDA kernel accessed managed memory that was residing on a different device, so the kernel execution paused and transferred the data to this device. Heavy traffic here will incur performance penalties, so consider using manual cudaMemcpyPeer operations to transfer from other devices' memory instead. The row showing these events is for the destination device -- the source device is shown in the tooltip for each transfer event.

DtoH transfer indicates the CPU accessed managed memory that was residing on a CUDA device, so the CPU execution paused and transferred the data to system memory. Heavy traffic here will incur performance penalties in CPU code, so consider using manual cudaMemcpy operations from pinned host memory instead.

Some Unified Memory transfers are highlighted with red to indicate potential performance issues:



Transfers with the following migration causes are highlighted:

- **Coherence**

  Unified Memory migration occurred to guarantee data coherence. SMs (streaming multiprocessors) stop until the migration completes.
- **Eviction**

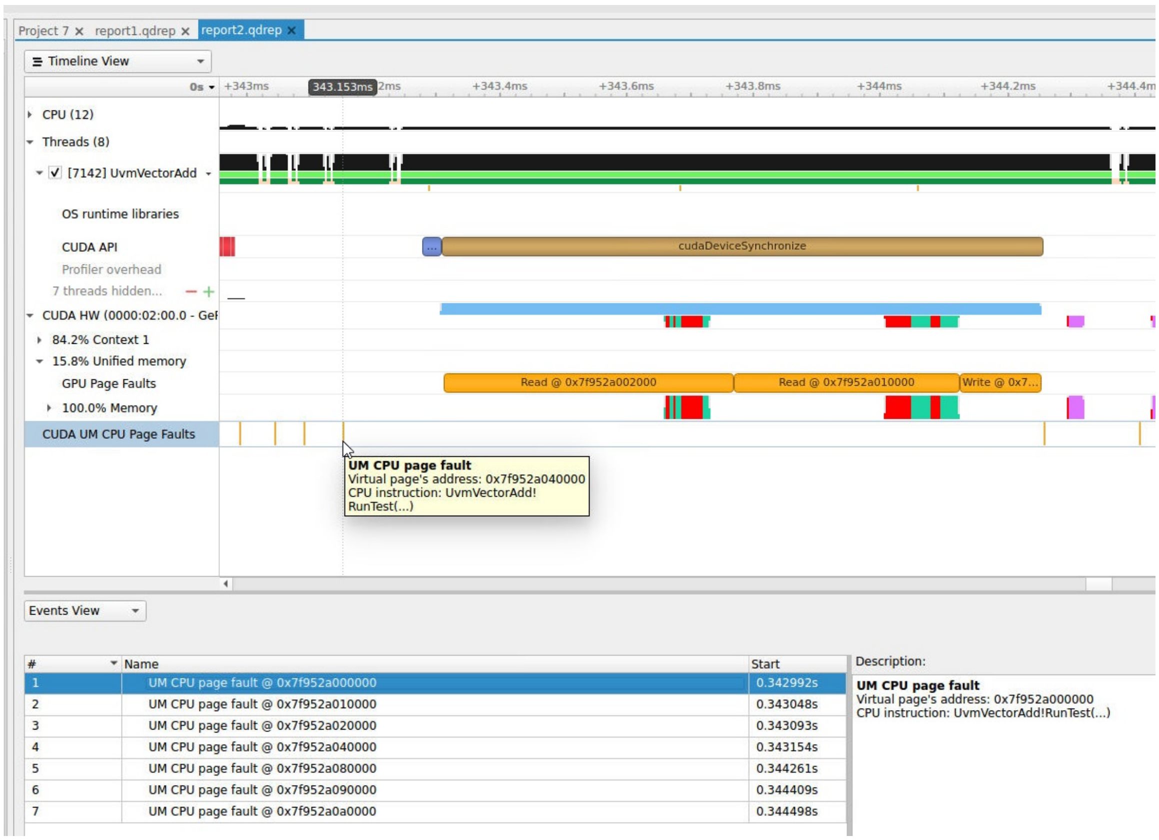
  Unified Memory migrated to the CPU because it was evicted to make room for another block of memory on the GPU. This happens due to memory overcommitment which is available on Linux with Compute Capability ≥ 6.

Unified Memory CPU Page Faults

The Unified Memory CPU page faults feature in Nsight Systems tracks the page faults that occur when CPU code tries to access a memory page that resides on the device.

Note:	Collecting Unified Memory CPU page faults can cause overhead of

up to 70% in testing. Please use this functionality only when needed.

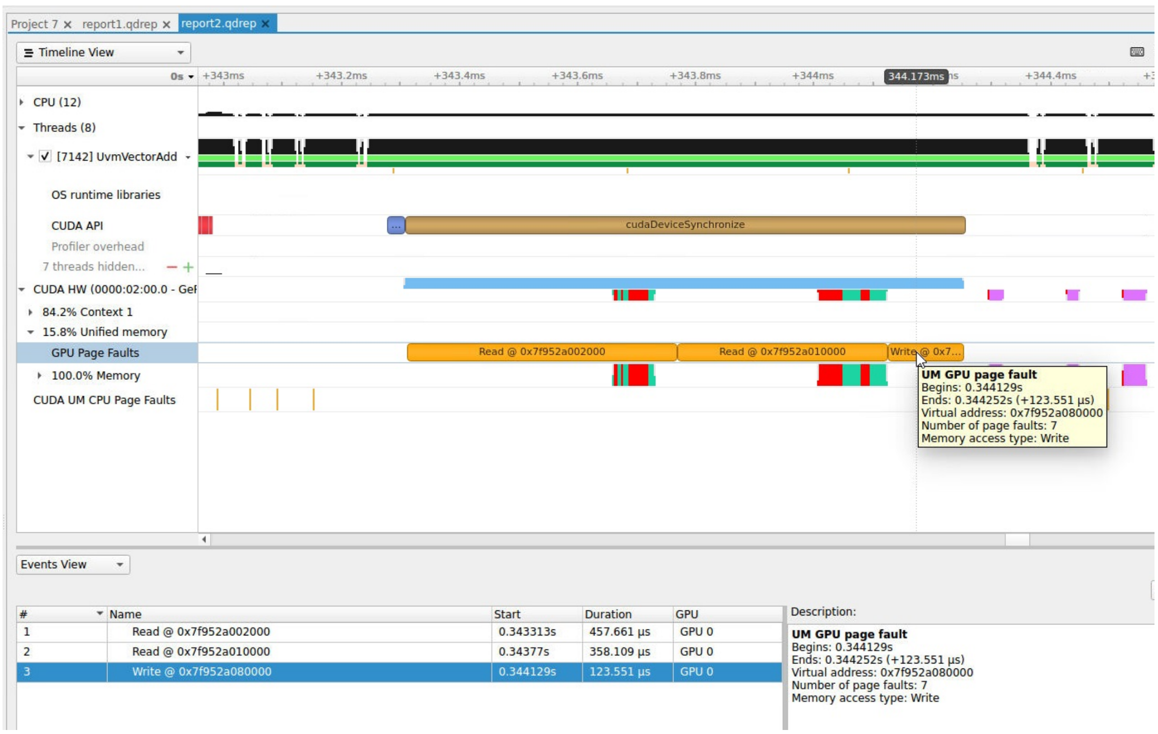


Unified Memory GPU Page Faults

The Unified Memory GPU page faults feature in Nsight Systems tracks the page faults that occur when GPU code tries to access a memory page that resides on the host.

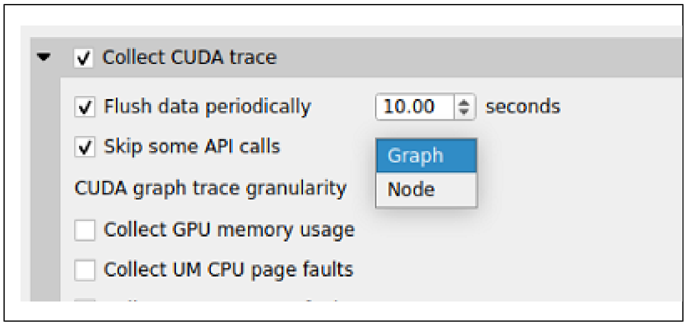
Note: Collecting Unified Memory GPU page faults can cause

	overhead of up to 70% in testing. Please use this functionality only when needed.

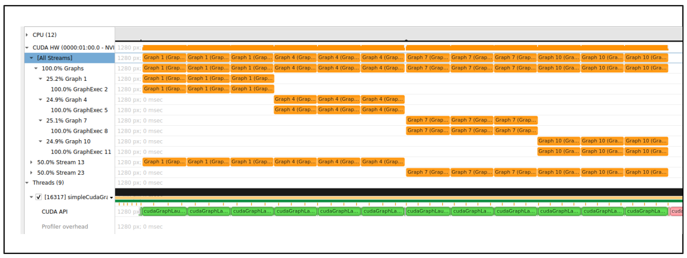


15.3. CUDA Graph Trace

Nsight Systems is capable of capturing information about CUDA graphs in your application at either the graph or node granularity. This can be set in the CLI using the **`--cuda-graph-trace`** option, or in the GUI by setting the appropriate drop down.



When CUDA graph trace is set to **`graph`**, the users sees each graph as one item on the timeline:



When CUDA graph trace is set to **`node`**, the users sees each graph as a set of nodes on the timeline:

Tracing CUDA graphs at the graph level rather than the tracing the underlying nodes results in significantly less overhead. This option is only available with CUDA driver 515.43 or higher.

15.4. CUDA Default Function List for CLI

CUDA Runtime API

```
cudaBindSurfaceToArray
cudaBindTexture
cudaBindTexture2D
cudaBindTextureToArray
cudaBindTextureToMipmappedArray
cudaConfigureCall
cudaCreateSurfaceObject
cudaCreateTextureObject
cudaD3D10MapResources
cudaD3D10RegisterResource
cudaD3D10UnmapResources
cudaD3D10UnregisterResource
cudaD3D9MapResources
cudaD3D9MapVertexBuffer
cudaD3D9RegisterResource
cudaD3D9RegisterVertexBuffer
cudaD3D9UnmapResources
cudaD3D9UnmapVertexBuffer
cudaD3D9UnregisterResource
cudaD3D9UnregisterVertexBuffer
cudaDestroySurfaceObject
cudaDestroyTextureObject
cudaDeviceReset
cudaDeviceSynchronize
cudaEGLStreamConsumerAcquireFrame
cudaEGLStreamConsumerConnect
cudaEGLStreamConsumerConnectWithFlags
cudaEGLStreamConsumerDisconnect
cudaEGLStreamConsumerReleaseFrame
cudaEGLStreamConsumerReleaseFrame
cudaEGLStreamProducerConnect
cudaEGLStreamProducerDisconnect
cudaEGLStreamProducerReturnFrame
cudaEventCreate
cudaEventCreateFromEGLSync
cudaEventCreateWithFlags
cudaEventDestroy
cudaEventQuery
cudaEventRecord
cudaEventRecord_ptsz
cudaEventSynchronize
cudaFree
cudaFreeArray
cudaFreeHost
cudaFreeMipmappedArray
cudaGLMapBufferObject
cudaGLMapBufferObjectAsync
cudaGLRegisterBufferObject
cudaGLUnmapBufferObject
cudaGLUnmapBufferObjectAsync
cudaGLUnregisterBufferObject
cudaGraphicsD3D10RegisterResource
cudaGraphicsD3D11RegisterResource
cudaGraphicsD3D9RegisterResource
cudaGraphicsEGLRegisterImage
cudaGraphicsGLRegisterBuffer
cudaGraphicsGLRegisterImage
cudaGraphicsMapResources
cudaGraphicsUnmapResources
cudaGraphicsUnregisterResource
cudaGraphicsVDPAURegisterOutputSurface
cudaGraphicsVDPAURegisterVideoSurface
cudaHostAlloc
cudaHostRegister
cudaHostUnregister
cudaLaunch
cudaLaunchCooperativeKernel
cudaLaunchCooperativeKernelMultiDevice
```

CUDA Primary API

```
cu64Array3DCreate
cu64ArrayCreate
cu64D3D9MapVertexBuffer
cu64GLMapBufferObject
cu64GLMapBufferObjectAsync
cu64MemAlloc
cu64MemAllocPitch
cu64MemFree
cu64MemGetInfo
cu64MemHostAlloc
cu64Memcpy2D
cu64Memcpy2DAsync
cu64Memcpy2DUnaligned
cu64Memcpy3D
cu64Memcpy3DAsync
cu64MemcpyAtoD
cu64MemcpyDtoA
cu64MemcpyDtoD
cu64MemcpyDtoDAsync
cu64MemcpyDtoH
cu64MemcpyDtoHAsync
cu64MemcpyHtoD
cu64MemcpyHtoDAsync
cu64MemsetD16
cu64MemsetD16Async
cu64MemsetD2D16
cu64MemsetD2D16Async
cu64MemsetD2D32
cu64MemsetD2D32Async
cu64MemsetD2D8
cu64MemsetD2D8Async
cu64MemsetD32
cu64MemsetD32Async
cu64MemsetD8
cu64MemsetD8Async
cuArray3DCreate
cuArray3DCreate_v2
cuArrayCreate
cuArrayCreate_v2
cuArrayDestroy
cuBinaryFree
cuCompilePtx
cuCtxCreate
cuCtxCreate_v2
cuCtxDestroy
cuCtxDestroy_v2
cuCtxSynchronize
cuD3D10CtxCreate
cuD3D10CtxCreateOnDevice
cuD3D10CtxCreate_v2
cuD3D10MapResources
cuD3D10RegisterResource
cuD3D10UnmapResources
cuD3D10UnregisterResource
cuD3D11CtxCreate
cuD3D11CtxCreateOnDevice
cuD3D11CtxCreate_v2
cuD3D9CtxCreate
cuD3D9CtxCreateOnDevice
cuD3D9CtxCreate_v2
cuD3D9MapResources
cuD3D9MapVertexBuffer
cuD3D9MapVertexBuffer_v2
cuD3D9RegisterResource
cuD3D9RegisterVertexBuffer
cuD3D9UnmapResources
cuD3D9UnmapVertexBuffer
cuD3D9UnregisterResource
cuD3D9UnregisterVertexBuffer
cuEGLStreamConsumerAcquireFrame
cuEGLStreamConsumerConnect
cuEGLStreamConsumerConnectWithFlags
cuEGLStreamConsumerDisconnect
cuEGLStreamConsumerReleaseFrame
```

15.5. cuDNN Function List for X86 CLI

cuDNN API functions

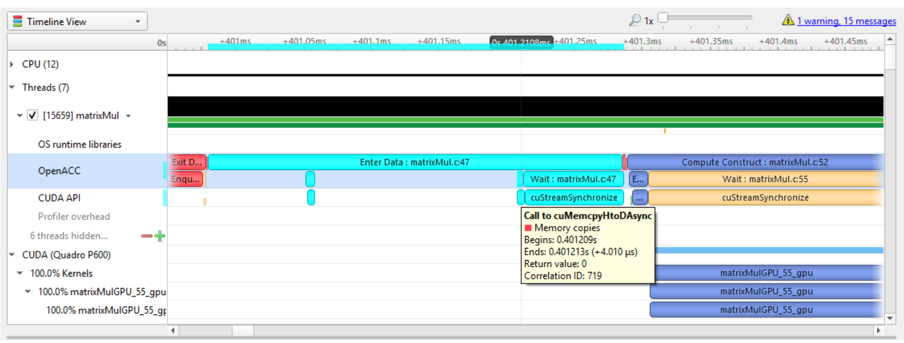
```
cudnnActivationBackward
cudnnActivationBackward_v3
cudnnActivationBackward_v4
cudnnActivationForward
cudnnActivationForward_v3
cudnnActivationForward_v4
cudnnAddTensor
cudnnBatchNormalizationBackward
cudnnBatchNormalizationBackwardEx
cudnnBatchNormalizationForwardInference
cudnnBatchNormalizationForwardTraining
cudnnBatchNormalizationForwardTrainingEx
cudnnCTCLoss
cudnnConvolutionBackwardBias
cudnnConvolutionBackwardData
cudnnConvolutionBackwardFilter
cudnnConvolutionBiasActivationForward
cudnnConvolutionForward
cudnnCreate
cudnnCreateAlgorithmPerformance
cudnnDestroy
cudnnDestroyAlgorithmPerformance
cudnnDestroyPersistentRNNPlan
cudnnDivisiveNormalizationBackward
cudnnDivisiveNormalizationForward
cudnnDropoutBackward
cudnnDropoutForward
cudnnDropoutGetReserveSpaceSize
cudnnDropoutGetStatesSize
cudnnFindConvolutionBackwardDataAlgorithm
cudnnFindConvolutionBackwardDataAlgorithmEx
cudnnFindConvolutionBackwardFilterAlgorithm
cudnnFindConvolutionBackwardFilterAlgorithmEx
cudnnFindConvolutionForwardAlgorithm
cudnnFindConvolutionForwardAlgorithmEx
cudnnFindRNNBackwardDataAlgorithmEx
cudnnFindRNNBackwardWeightsAlgorithmEx
cudnnFindRNNForwardInferenceAlgorithmEx
cudnnFindRNNForwardTrainingAlgorithmEx
cudnnFusedOpsExecute
cudnnIm2Col
cudnnLRNCrossChannelBackward
cudnnLRNCrossChannelForward
cudnnMakeFusedOpsPlan
cudnnMultiHeadAttnBackwardData
cudnnMultiHeadAttnBackwardWeights
cudnnMultiHeadAttnForward
cudnnOpTensor
cudnnPoolingBackward
cudnnPoolingForward
cudnnRNNBackwardData
cudnnRNNBackwardDataEx
cudnnRNNBackwardWeights
cudnnRNNBackwardWeightsEx
cudnnRNNForwardInference
cudnnRNNForwardInferenceEx
cudnnRNNForwardTraining
cudnnRNNForwardTrainingEx
cudnnReduceTensor
cudnnReorderFilterAndBias
cudnnRestoreAlgorithm
cudnnRestoreDropoutDescriptor
cudnnSaveAlgorithm
cudnnScaleTensor
cudnnSoftmaxBackward
cudnnSoftmaxForward
cudnnSpatialTfGridGeneratorBackward
cudnnSpatialTfGridGeneratorForward
```

Chapter 16. OPENACC TRACE

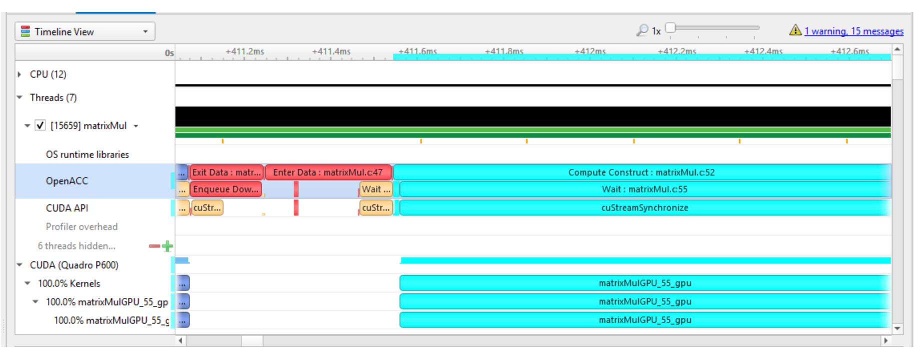
Nsight Systems for Linux x86_64 and Power targets is capable of capturing information about OpenACC execution in the profiled process.

OpenACC versions 2.0, 2.5, and 2.6 are supported when using PGI runtime version 15.7 or later. In order to differentiate constructs (see tooltip below), a PGI runtime of 16.0 or later is required. Note that Nsight Systems does not support the GCC implementation of OpenACC at this time.

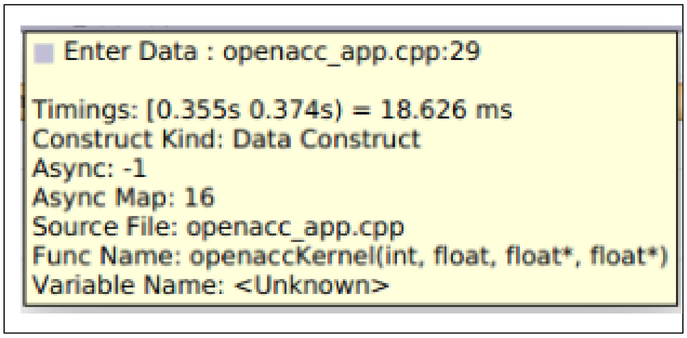
Under the CPU rows in the timeline tree, each thread that uses OpenACC will show OpenACC trace information. You can click on a OpenACC API call to see correlation with the underlying CUDA API calls (highlighted in teal):



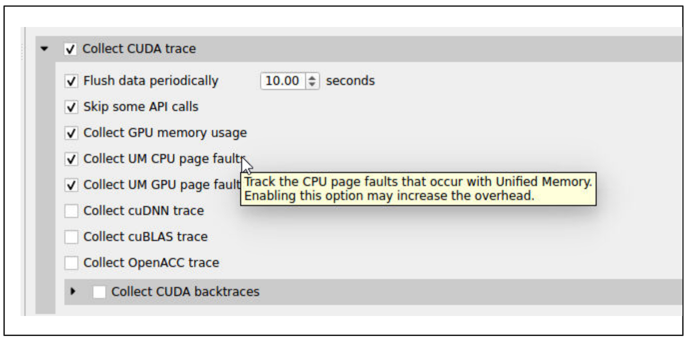
If the OpenACC API results in GPU work, that will also be highlighted:



Hovering over a particular OpenACC construct will bring up a tooltip with details about that construct:



To capture OpenACC information from the Nsight Systems GUI, select the **Collect OpenACC trace** checkbox under **Collect CUDA trace** configurations. Note that turning on OpenACC tracing will also turn on CUDA tracing.



Please note that if your application crashes before all collected OpenACC trace data has been copied out, some or all data might be lost and not present in the report.

Chapter 17. OPENGL TRACE

OpenGL and OpenGL ES APIs can be traced to assist in the analysis of CPU and GPU interactions.

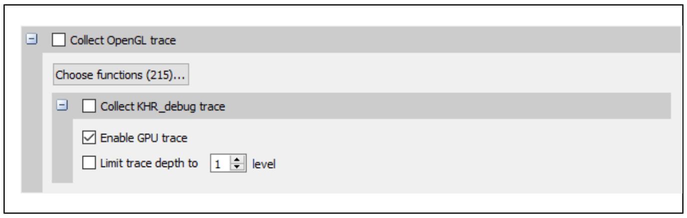
A few usage examples are:

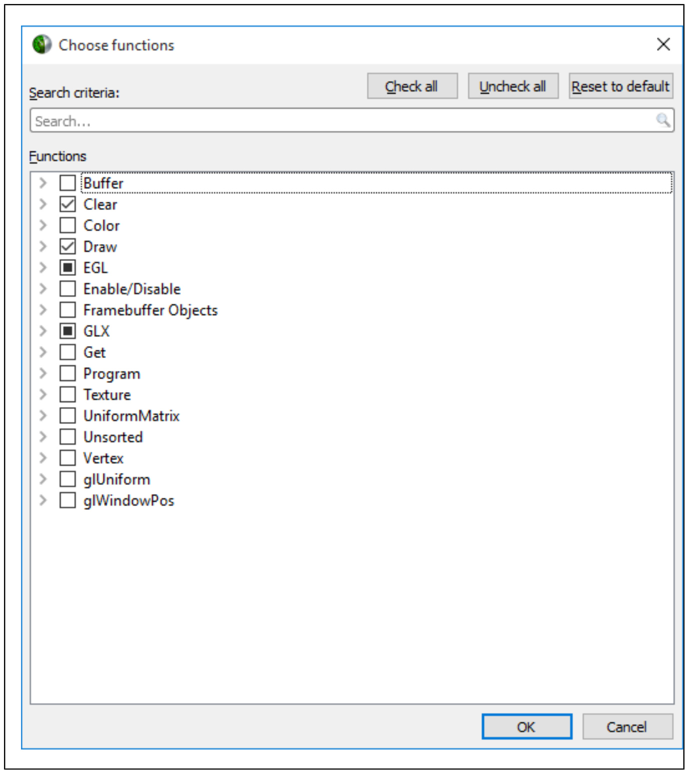
1. Visualize how long **`eglSwapBuffers`** (or similar) is taking.
2. API trace can easily show correlations between thread state and graphics driver's behavior, uncovering where the CPU may be waiting on the GPU.
3. Spot bubbles of opportunity on the GPU, where more GPU workload could be created.
4. Use **`KHR_debug`** extension to trace GL events on both the CPU and GPU.

OpenGL trace feature in Nsight Systems consists of two different activities which will be shown in the CPU rows for those threads

- **CPU trace**: interception of API calls that an application does to APIs (such as OpenGL, OpenGL ES, EGL, GLX, WGL, etc.).
- **GPU trace** (or **workload trace**): trace of GPU workload (activity) triggered by use of OpenGL or OpenGL ES. Since draw calls are executed back-to-back, the GPU workload trace ranges include many OpenGL draw calls and operations in order to optimize performance overhead, rather than tracing each individual operation.

To collect GPU trace, the **`glQueryCounter()`** function is used to measure how much time batches of GPU workload take to complete.





Ranges defined by the **`KHR_debug`** calls are represented similarly to OpenGL API and OpenGL GPU workload trace. GPU ranges in this case represent *incremental draw cost*. They cannot fully account for GPUs that can execute multiple draw calls in parallel. In this case, Nsight Systems will not show overlapping GPU ranges.

17.1. OpenGL Trace Using Command Line

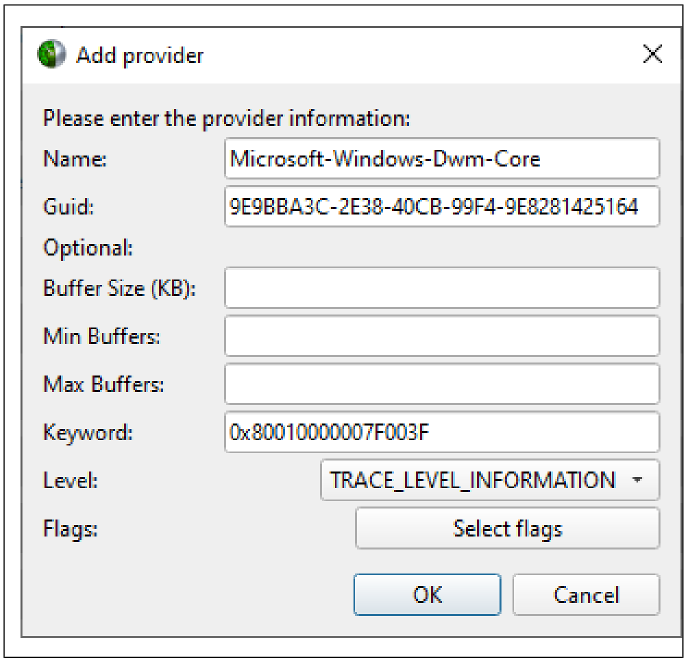
For general information on using the target CLI, see CLI Profiling on Linux. For the CLI, the functions that are traced are set to the following list:

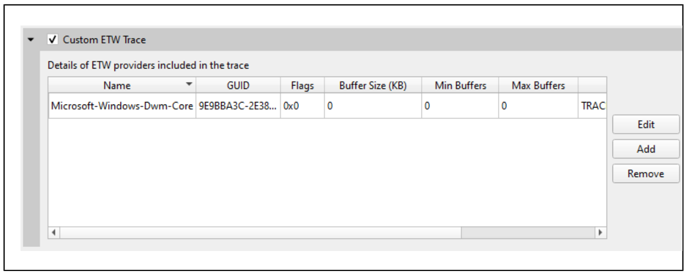
```
glWaitSync
glReadPixels
glReadnPixelsKHR
glReadnPixelsEXT
glReadnPixelsARB
glReadnPixels
glFlush
glFinishFenceNV
glFinish
glClientWaitSync
glClearTexSubImage
glClearTexImage
glClearStencil
glClearNamedFramebufferuiv
glClearNamedFramebufferiv
glClearNamedFramebufferfv
glClearNamedFramebufferfi
glClearNamedBufferSubDataEXT
glClearNamedBufferSubData
glClearNamedBufferDataEXT
glClearNamedBufferData
glClearIndex
glClearDepthx
glClearDepthf
glClearDepthdNV
glClearDepth
glClearColorx
glClearColorIuiEXT
glClearColorIiEXT
glClearColor
glClearBufferuiv
glClearBufferSubData
glClearBufferiv
glClearBufferfv
glClearBufferfi
glClearBufferData
glClearAccum
glClear
glDispatchComputeIndirect
glDispatchComputeGroupSizeARB
glDispatchCompute
glComputeStreamNV
glNamedFramebufferDrawBuffers
glNamedFramebufferDrawBuffer
glMultiDrawElementsIndirectEXT
glMultiDrawElementsIndirectCountARB
glMultiDrawElementsIndirectBindlessNV
glMultiDrawElementsIndirectBindlessCountNV
glMultiDrawElementsIndirectAMD
glMultiDrawElementsIndirect
glMultiDrawElementsEXT
glMultiDrawElementsBaseVertex
glMultiDrawElements
glMultiDrawArraysIndirectEXT
glMultiDrawArraysIndirectCountARB
glMultiDrawArraysIndirectBindlessNV
glMultiDrawArraysIndirectBindlessCountNV
glMultiDrawArraysIndirectAMD
glMultiDrawArraysIndirect
glMultiDrawArraysEXT
glMultiDrawArrays
glListDrawCommandsStatesClientNV
glFramebufferDrawBuffersEXT
glFramebufferDrawBufferEXT
glDrawTransformFeedbackStreamInstanced
glDrawTransformFeedbackStream
glDrawTransformFeedbackNV
```

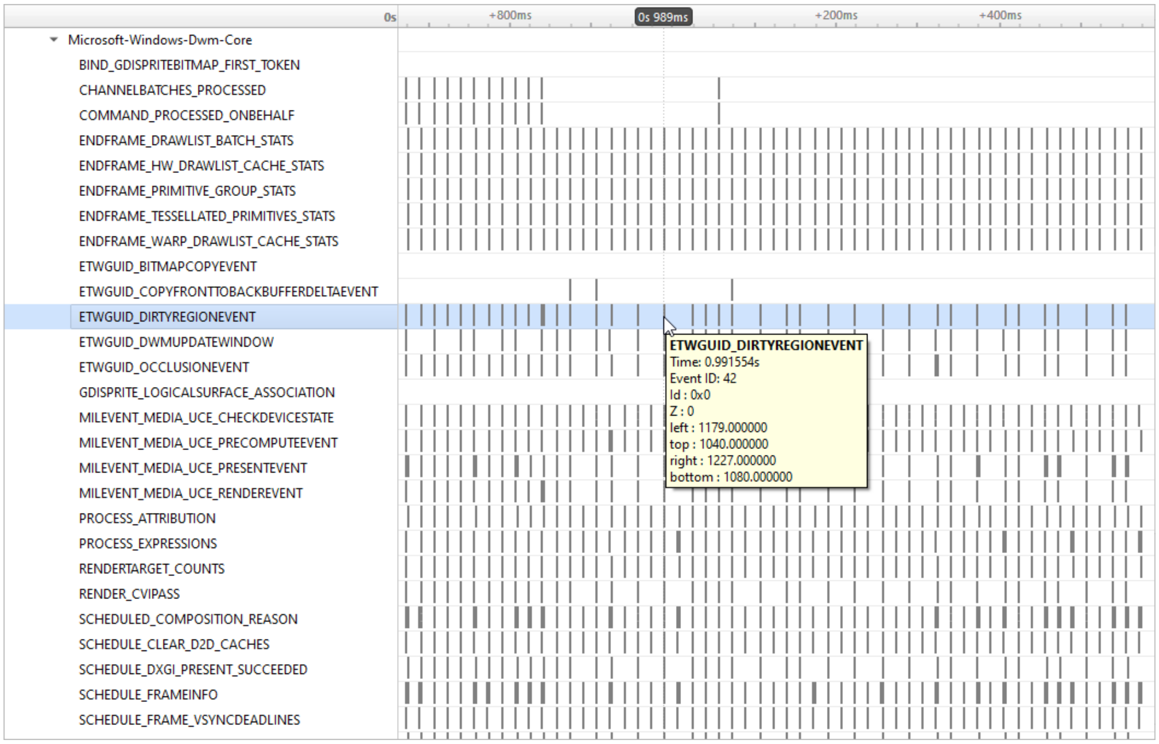
Chapter 18.
CUSTOM ETW TRACE

Use the custom ETW trace feature to enable and collect any manifest-based ETW log. The collected events are displayed on the timeline on dedicated rows for each event type.

Custom ETW is available on Windows target machines.







To retain the .etl trace files captured, so that they can be viewed in other tools (e.g. GPUView), change the "Save ETW log files in project folder" option under "Profile Behavior" in Nsight Systems's global Options dialog. The .etl files will appear in the same folder as the .nsys-rep file, accessible by right-clicking the report in the Project Explorer and choosing "Show in Folder...". Data collected from each ETW provider will appear in its own .etl file, and an additional .etl file named "Report XX-Merged-*.etl", containing the events from all captured sources, will be created as well.

Chapter 19. GPU METRICS

Overview

GPU Metrics feature is intended to identify performance limiters in applications using GPU for computations and graphics. It uses periodic sampling to gather performance metrics and detailed timing statistics associated with different GPU hardware units taking advantage of specialized hardware to capture this data in a single pass with minimal overhead.

Note: GPU Metrics will give you precise device level information, but it does not know which process or context is involved. GPU context switch trace provides less precise information, but will give you process and context information.

These metrics provide an overview of GPU efficiency over time within compute, graphics, and input/output (IO) activities such as:

- **IO throughputs:** PCIe, NVLink, and GPU memory bandwidth
- **SM utilization:** SMs activity, tensor core activity, instructions issued, warp occupancy, and unassigned warp slots

It is designed to help users answer the common questions:

- Is my GPU idle?
- Is my GPU full? Enough kernel grids size and streams? Are my SMs and warp slots full?
- Am I using TensorCores?
- Is my instruction rate high?
- Am I possibly blocked on IO, or number of warps, etc

Nsight Systems GPU Metrics is only available for Linux targets on x86-64 and aarch64, and for Windows targets. It requires NVIDIA Turing architecture or newer.

Minimum required driver versions:

- NVIDIA Turing architecture TU10x, TU11x - r440
- NVIDIA Ampere architecture GA100 - r450
- NVIDIA Ampere architecture GA100 MIG - r470 TRD1
- NVIDIA Ampere architecture GA10x - r455

Note: **Permissions:** Elevated permissions are required. On Linux use sudo to elevate privileges. On Windows the user must run from an admin command prompt or accept the UAC escalation dialog. See Permissions Issues and

	Performance Counters for more information.
Note:	**Tensor Core:** If you run **nsys profile --gpu-metrics-device all**, the Tensor Core utilization can be found in the GUI under the **SM instructions/Tensor Active** row. Please note that it is not practical to expect a CUDA kernel to reach 100% Tensor Core utilization since there are other overheads.

	In general, the more computation-intensive an operation is, the higher Tensor Core utilization rate the CUDA kernel can achieve.

Launching GPU Metric from the CLI

GPU Metrics feature is controlled with 3 CLI switches:

- --gpu-metrics-device=[all, none, <index>] selects GPUs to sample (default is none)
- --gpu-metrics-set=[<index>, <alias>] selects metric set to use (default is the 1st suitable from the list)
- --gpu-metrics-frequency=[10..200000] selects sampling frequency in Hz (default is 10000)

To profile with default options and sample GPU Metrics on GPU 0:

```
# Must have elevated permissions (see https://developer.nvidia.com/
ERR_NVGPUCTRPERM) or be root (Linux) or Administrator (Windows)
$ nsys profile --gpu-metrics-device=0 ./my-app
```

To list available GPUs, use:

```
$ nsys profile --gpu-metrics-device=help
Possible --gpu-metrics-device values are:
    0: Quadro GV100 PCI[0000:17:00.0]
    1: GeForce RTX 2070 SUPER PCI[0000:65:00.0]
    all: Select all supported GPUs
    none: Disable GPU Metrics [Default]
```

By default, the first **metric set** which supports all selected GPUs is used. But you can manually select another metric set from the list. To see available metric sets, use:

```
$ nsys profile --gpu-metrics-set=help
Possible --gpu-metrics-set values are:
    [0] [tu10x]        General Metrics for NVIDIA TU10x (any frequency)
    [1] [tu11x]        General Metrics for NVIDIA TU11x (any frequency)
    [2] [ga100]        General Metrics for NVIDIA GA100 (any frequency)
    [3] [ga10x]        General Metrics for NVIDIA GA10x (any frequency)
    [4] [tu10x-gfxt]   Graphics Throughput Metrics for NVIDIA TU10x (frequency
 >= 10kHz)
    [5] [ga10x-gfxt]   Graphics Throughput Metrics for NVIDIA GA10x (frequency
 >= 10kHz)
    [6] [ga10x-gfxact] Graphics Async Compute Triage Metrics for NVIDIA GA10x
 (frequency >= 10kHz)
```

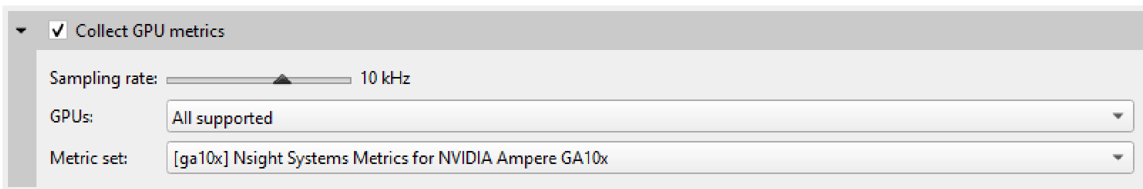
By default, **sampling frequency** is set to 10 kHz. But you can manually set it from 10 Hz to 200 kHz using

```
--gpu-metrics-frequency=<value>
```

Launching GPU Metrics from the GUI

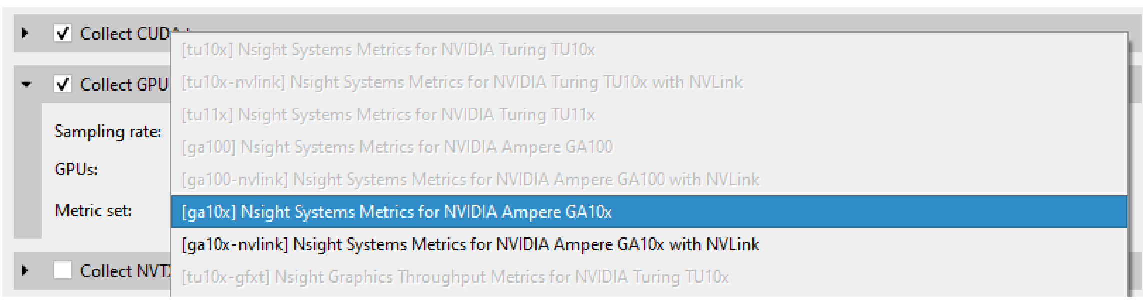
For commands to launch GPU Metrics from the CLI with examples, see the CLI documentation.

When launching analysis in Nsight Systems, select **Collect GPU Metrics**.



Select the **GPUs** dropdown to pick which GPUs you wish to sample.

Select the **Metric set:** dropdown to choose which available metric set you would like to sample.



Note that metric sets for GPUs that are not being sampled will be greyed out.

Sampling frequency

Sampling frequency can be selected from the range of 10 Hz - 200 kHz. The default value is 10 kHz.

The maximum sampling frequency without buffer overflow events depends on GPU (SM count), GPU load intensity, and overall system load. The bigger the chip and the higher the load, the lower the maximum frequency. If you need higher frequency, you can increase it until you get "Buffer overflow" message in the Diagnostics Summary report page.

Each metric set has a recommended sampling frequency range in its description. These ranges are approximate. If you observe **`Inonsistent Data`** or **`Missing Data`** ranges on timeline, please try closer to the recommended frequency.

Available metrics

- **GPC Clock Frequency** - **`gpc__cycles_elapsed.avg.per_second`**

  The average GPC clock frequency in hertz. In public documentation the GPC clock may be called the "Application" clock, "Graphic" clock, "Base" clock, or "Boost" clock.

  Note: The collection mechanism for GPC can result in a small fluctuation between samples.
- **SYS Clock Frequency** - **`sys__cycles_elapsed.avg.per_second`**

  The average SYS clock frequency in hertz. The GPU front end (command processor), copy engines, and the performance monitor run at the SYS clock. On Turing and NVIDIA GA100 GPUs the sampling frequency is based upon a period of SYS clocks (not time) so samples per second will vary with SYS clock. On NVIDIA GA10x GPUs the sampling frequency is based upon a fixed frequency clock. The maximum frequency scales linearly with the SYS clock.
- **GR Active** - **`gr__cycles_active.sum.pct_of_peak_sustained_elapsed`**

  The percentage of cycles the graphics/compute engine is active. The graphics/ compute engine is active if there is any work in the graphics pipe or if the compute pipe is processing work.

  GA100 MIG - MIG is not yet supported. This counter will report the activity of the primary GR engine.
- **Sync Compute In Flight** - **`gr__dispatch_cycles_active_queue_sync.avg.pct_of_peak_sustained_elapsed`**

  The percentage of cycles with synchronous compute in flight.

  CUDA: CUDA will only report synchronous queue in the case of MPS configured with 64 sub-context. Synchronous refers to work submitted in VEID=0.

  Graphics: This will be true if any compute work submitted from the direct queue is in flight.
- **Async Compute in Flight** - **`gr__dispatch_cycles_active_queue_async.avg.pct_of_peak_sustained_elapsed`**

  The percentage of cycles with asynchronous compute in flight.

  CUDA: CUDA will only report all compute work as asynchronous. The one exception is if MPS is configured and all 64 sub-context are in use. 1 sub-context (VEID=0) will report as synchronous.

  Graphics: This will be true if any compute work submitted from a compute queue is in flight.
- **Draw Started** - **`fe__draw_count.avg.pct_of_peak_sustained_elapsed`**

  The ratio of draw calls issued to the graphics pipe to the maximum sustained rate of the graphics pipe.

Note: The percentage will always be very low as the front end can issue draw calls significantly faster than the pipe can execute the draw call. The rendering of this row will be changed to help indicate when draw calls are being issued.

- **Dispatch Started** - **`gr__dispatch_count.avg.pct_of_peak_sustained_elapsed`**

  The ratio of compute grid launches (dispatches) to the compute pipe to the maximum sustained rate of the compute pipe.

  Note: The percentage will always be very low as the front end can issue grid launches significantly faster than the pipe can execute the draw call. The rendering of this row will be changed to help indicate when grid launches are being issued.
- **Vertex/Tess/Geometry Warps in Flight** - **`tpc__warps_active_shader_vtg_realtime.avg.pct_of_peak_sustained_elapsed`**

  The ratio of active vertex, geometry, tessellation, and meshlet shader warps resident on the SMs to the maximum number of warps per SM as a percentage.
- **Pixel Warps in Flight** - **`tpc__warps_active_shader_ps_realtime.avg.pct_of_peak_sustained_elapsed`**

  The ratio of active pixel/fragment shader warps resident on the SMs to the maximum number of warps per SM as a percentage.
- **Compute Warps in Flight** - **`tpc__warps_active_shader_cs_realtime.avg.pct_of_peak_sustained_elapsed`**

  The ratio of active compute shader warps resident on the SMs to the maximum number of warps per SM as a percentage.
- **Active SM Unused Warp Slots** - **`tpc__warps_inactive_sm_active_realtime.avg.pct_of_peak_sustained_elapsed`**

  The ratio of inactive warp slots on the SMs to the maximum number of warps per SM as a percentage. This is an indication of how many more warps may fit on the SMs if occupancy is not limited by a resource such as max warps of a shader type, shared memory, registers per thread, or thread blocks per SM.
- **Idle SM Unused Warp Slots** - **`tpc__warps_inactive_sm_idle_realtime.avg.pct_of_peak_sustained_elapsed`**

  The ratio of inactive warps slots due to idle SMs to the the maximum number of warps per SM as a percentage.

  This is an indicator that the current workload on the SM is not sufficient to put work on all SMs. This can be due to:

  - CPU starving the GPU
  - current work is too small to saturate the GPU
  - current work is trailing off but blocking next work
- **SM Active** - **`sm__cycles_active.avg.pct_of_peak_sustained_elapsed`**

  The ratio of cycles SMs had at least 1 warp in flight (allocated on SM) to the number of cycles as a percentage. A value of 0 indicates all SMs were idle (no warps in flight). A value of 50% can indicate some gradient between all SMs active 50% of the sample period or 50% of SMs active 100% of the sample period.

- **SM Issue** - **`sm__inst_executed_realtime.avg.pct_of_peak_sustained_elapsed`**

  The ratio of cycles that SM sub-partitions (warp schedulers) issued an instruction to the number of cycles in the sample period as a percentage.
- **Tensor Active** - **`sm__pipe_tensor_cycles_active_realtime.avg.pct_of_peak_sustained_elapsed`**

  The ratio of cycles the SM tensor pipes were active issuing tensor instructions to the number of cycles in the sample period as a percentage.

  TU102/4/6: This metric is not available on TU10x for periodic sampling. Please see Tensor Active/FP16 Active.
- **Tensor Active / FP16 Active** - **`sm__pipe_shared_cycles_active_realtime.avg.pct_of_peak_sustained_elapsed`**

  TU102/4/6 only

  The ratio of cycles the SM tensor pipes or FP16x2 pipes were active issuing tensor instructions to the number of cycles in the sample period as a percentage.
- **VRAM Bandwidth** - **`dram__throughput.avg.pct_of_peak_sustained_elapsed`**

  The ratio of cycles the GPU device memory controllers were actively performing read or write operations to the number of cycles in the sample period as a percentage.
- **NVLink bytes received** - **`nvlrx__bytes.avg.pct_of_peak_sustained_elapsed`**

  The ratio of bytes received on the NVLink interface to the maximum number of bytes receivable in the sample period as a percentage. This value includes protocol overhead.
- **NVLink bytes transmitted** - **`nvltx__bytes.avg.pct_of_peak_sustained_elapsed`**

  The ratio of bytes transmitted on the NVLink interface to the maximum number of bytes transmittable in the sample period as a percentage. This value includes protocol overhead.
- **PCIe Read Throughput** - **`pcie__read_bytes.avg.pct_of_peak_sustained_elapsed`**

  The ratio of bytes received on the PCIe interface to the maximum number of bytes receivable in the sample period as a percentage. The theoretical value is calculated based upon the PCIe generation and number of lanes. This value includes protocol overhead.
- **PCIe Write Throughput** - **`pcie__write_bytes.avg.pct_of_peak_sustained_elapsed`**

  The ratio of bytes received on the PCIe interface to the maximum number of bytes receivable in the sample period as a percentage. The theoretical value is calculated based upon the PCIe generation and number of lanes. This value includes protocol overhead.

Exporting and Querying Data

It is possible to access metric values for automated processing using the Nsight Systems CLI export capabilities.

An example that extracts values of "SM Active":

```
     $ nsys export -t sqlite report.nsys-rep
     $ sqlite3 report.sqlite "SELECT rawTimestamp, CAST(JSON_EXTRACT(data, '$.
\"SM Active\"') as INTEGER) as value FROM GENERIC_EVENTS WHERE value != 0 LIMIT
 10"

     309277039|80
     309301295|99
     309325583|99
     309349776|99
     309373872|60
     309397872|19
     309421840|100
     309446000|100
     309470096|100
     309494161|99
```

An overview of data stored in each event (JSON):

```
     $ sqlite3 report.sqlite "SELECT data FROM GENERIC_EVENTS LIMIT 1"
     {
     "Unallocated Warps in Active SM": "0",
     "Compute Warps In Flight": "52",
     "Pixel Warps In Flight": "0",
     "Vertex\/Tess\/Geometry Warps In Flight": "0",
     "Total SM Occupancy": "52",
     "GR Active (GE\/CE)": "100",
     "Sync Compute In Flight": "0",
     "Async Compute In Flight": "98",
     "NVLink bytes received": "0",
     "NVLink bytes transmitted": "0",
     "PCIe Rx Throughput": "0",
     "PCIe Tx Throughput": "1",
     "DRAM Read Throughput": "0",
     "DRAM Write Throughput": "0",
     "Tensor Active \/ FP16 Active": "0",
     "SM Issue": "10",
     "SM Active": "52"
     }
```

Values are integer percentages (0..100)

Limitations

- If metric sets with NVLink are used but the links are not active, they may appear as fully utilized.
- Only one tool that subscribes to these counters can be used at a time, therefore, Nsight Systems GPU Metrics feature cannot be used at the same time as the following tools:

    - Nsight Graphics
    - Nsight Compute
    - DCGM (Data Center GPU Manager)

      Use the following command:

        - dcgmi profile --pause
        - dcgmi profile --resume

      Or API:

        - dcgmProfPause
        - dcgmProfResume
    - Non-NVIDIA products which use:
        - CUPTI sampling used directly in the application. CUPTI trace is okay (although it will block Nsight Systems CUDA trace)
        - DCGM library
- Nsight Systems limits the amount of memory that can be used to store GPU Metrics samples. Analysis with higher sampling rates or on GPUs with more SMs has a risk of exceeding this limit. This will lead to gaps on timeline filled with **`Missing Data`** ranges. Future releases will reduce the frequency of this happening.

Chapter 20. CPU PROFILING USING LINUX OS PERF SUBSYSTEM

Nsight Systems on Linux targets, utilizes the Linux OS' perf subsystem to sample CPU Instruction Pointers (IPs) and backtraces, trace CPU context switches, and sample CPU and OS event counts. The Linux perf tool utilizes the same perf subsystem.

Nsight Systems, on L4T and potentially other ARM targets, may use a custom kernel module to collect the same data. The Nsight Systems CLI command **`nsys status --environment`** indicates when the kernel module is used instead of the Linux OS' perf subsystem.

Features

- **CPU Instruction Pointer / Backtrace Sampling**

  Nsight Systems can sample CPU Instruction Pointers / backtraces periodically. The collection of a sample is triggered by a hardware event overflow - e.g. a sample is collected after every 1 million CPU reference cycles on a per thread basis. In the GUI, samples are shown on the individual thread timelines, in the Event Viewer, and in the Top Down, Bottom Up, or Flat views which provide histogram-like summaries of the data. IP / backtrace collections can be configured in process-tree or system-wide mode. In process-tree mode, Nsight Systems will sample the process, and any of its descendants, launched by the tool. In system-wide mode, Nsight Systems will sample all processes running on the system, including any processes launched by the tool.
- **CPU Context Switch Tracing**

  Nsight Systems can trace every time the OS schedules a thread on a logical CPU and every time the OS thread gets unscheduled from a logical CPU. The data is used to show CPU utilization and OS thread utilization within the Nsight Systems GUI. Context switch collections can be configured in process-tree or system-wide mode. In process-tree mode, Nsight Systems will trace the process, and any of its descendants, launched by Nsight Systems. In system-wide mode, Nsight Systems will trace all processes running on the system, including any processes launched by the Nsight Systems.
- **CPU Event Sampling**

Nsight Systems can periodically sample CPU hardware event counts and OS event counts and show the event's rate over time in the Nsight Systems GUI. Event sample collections can be configured in system-wide mode only. In system-wide mode, Nsight Systems will sample event counts of all CPUs and the OS event counts running on the system. Event counts are not directly associated with processes or threads.

System Requirements

- **Paranoid Level**

  The system's paranoid level must be 2 or lower.

Paranoid Level	CPU IP/ backtrace Sampling process-tree mode	CPU IP/ backtrace Sampling system-wide mode	CPU Context Switch Tracing process-tree mode	CPU Context Switch Tracing system-wide mode	Event Sampling system-wide mode
3 or greater	not available	not available	not available	not available	not available
2	User mode IP/ backtrace samples only	not available	available	not available	not available
1	Kernel and user mode IP/ backtrace samples	not available	available	not available	not available
0, -1	Kernel and user mode IP/ backtrace samples	Kernel and user mode IP/ backtrace samples	available	available	hardware and OS events

- **Kernel Version**

  To support the CPU profiling features utilized by Nsight Systems, the kernel version must be greater than or equal to v4.3. RedHat has backported the required features to the v3.10.0-693 kernel. RedHat distros and their derivatives (e.g. CentOS) require a 3.10.0-693 or later kernel. Use the **`uname -r`** command to check the kernel's version.

- **perf_event_open syscall**

  The perf_event_open syscall needs to be available. When running within a Docker container, the default seccomp settings will normally block the perf_event_open syscall. To workaround this issue, use the Docker **`run --privileged`** switch when launching the docker or modify the docker's seccomp settings. Some VMs (virtual machines), e.g. AWS, may also block the perf_event_open syscall.
- **Sampling Trigger**

  In some rare case, a sampling trigger is not available. The sampling trigger is either a hardware or software event that causes a sample to be collected. Some VMs block hardware events from being accessed and therefore, prevent hardware events from being used as sampling triggers. In those cases, Nsight Systems will fall back to using a software trigger if possible.
- **Checking Your Target System**

  Use the **`nsys status --environment`** command to check if a system meets the Nsight Systems CPU profiling requirements. Example output from this command is shown below. Note that this command does not check for Linux capability overrides - i.e. if the user or executable files have CAP_SYS_ADMIN or CAP_PERFMON capability. Also, note that this command does not indicate if system-wide mode can be used.

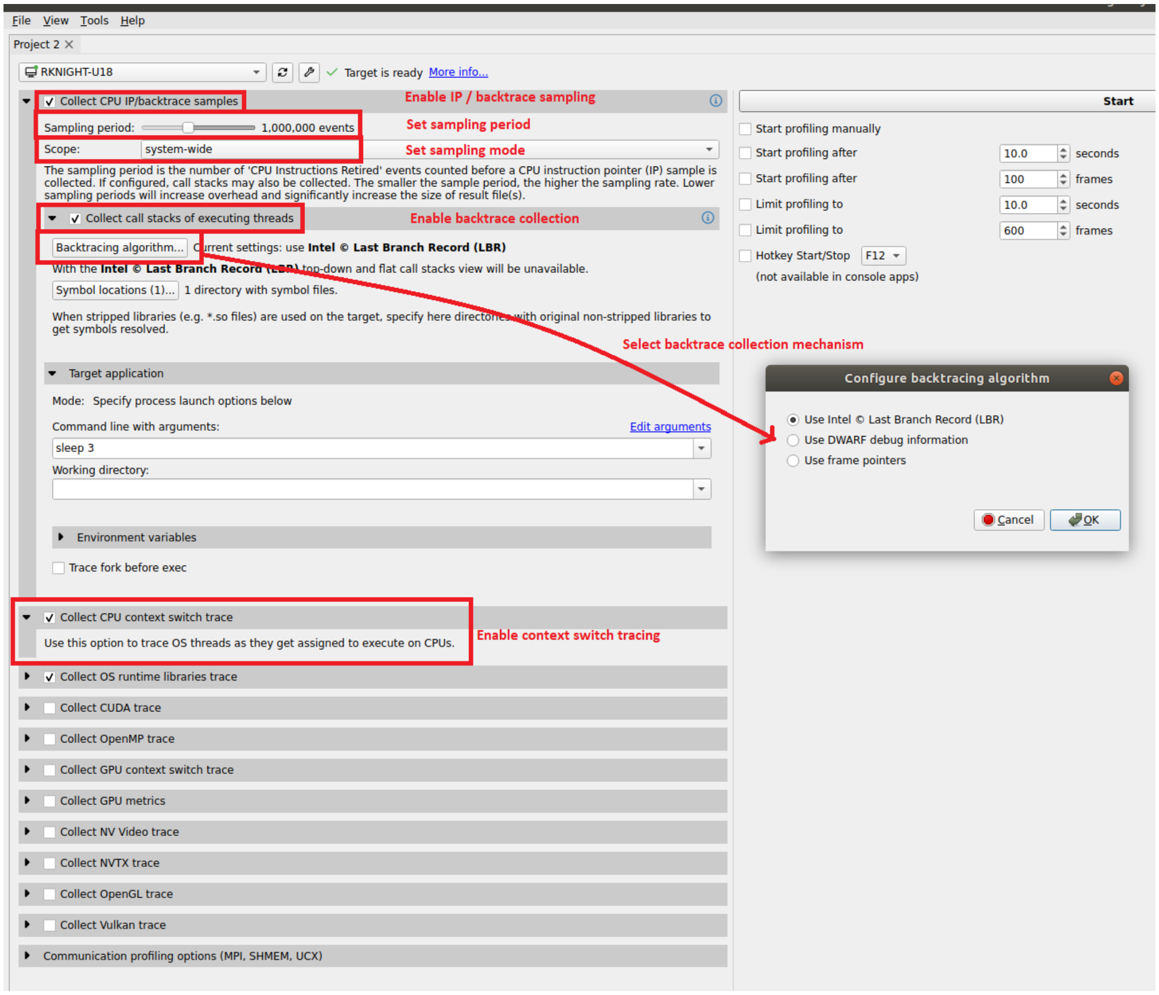
```
(base) rknight@RKNIGHT-U18:~/quadd2/quadd/Built/Bin/QuadD-Debug/target-linux-x64$ ./nsys status -e
Timestamp counter supported: Yes

CPU Profiling Environment Check
Root privilege: disabled
Linux Kernel Paranoid Level = 2
Linux Distribution = Ubuntu
Linux Kernel Version = 5.4.0-122-generic: OK
Linux perf_event_open syscall available: OK
Sampling trigger event available: OK
Intel(c) Last Branch Record support: Available
CPU Profiling Environment (process-tree): OK
CPU Profiling Environment (system-wide): Fail

See the product documentation at https://docs.nvidia.com/nsight-systems for more information,
including information on how to set the Linux Kernel Paranoid Level.
```

Configuring a CPU Profiling Collection

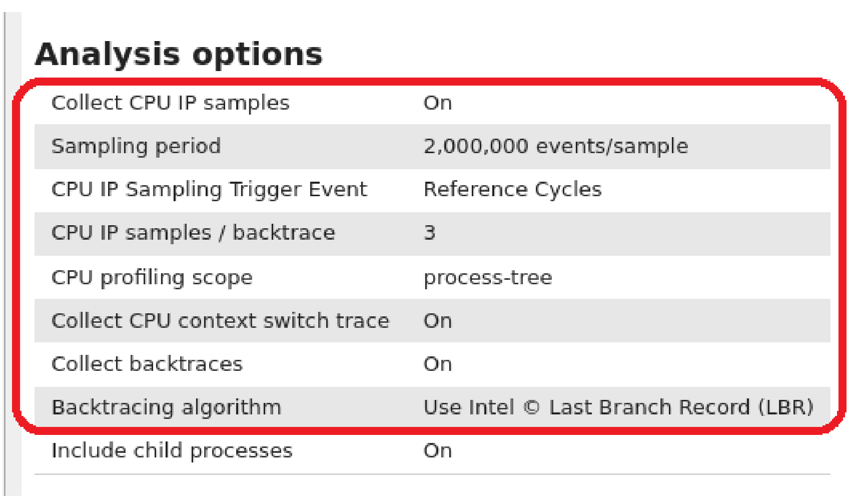
When configuring Nsight Systems for CPU Profiling from the CLI, use some or all of the following options: **`--sample`**, **`--cpuctxsw`**, **`--event-sample`**, **`--backtrace`**, **`--cpu-core-events`**, **`--event-sampling-frequency`**, **`--os-events`**, **`--samples-per-backtrace`**, and **`--sampling-period`**.

Details about these options, including examples can be found in the Profiling from the CLI section of the User Guide

When configuring from the GUI, the following options are available:



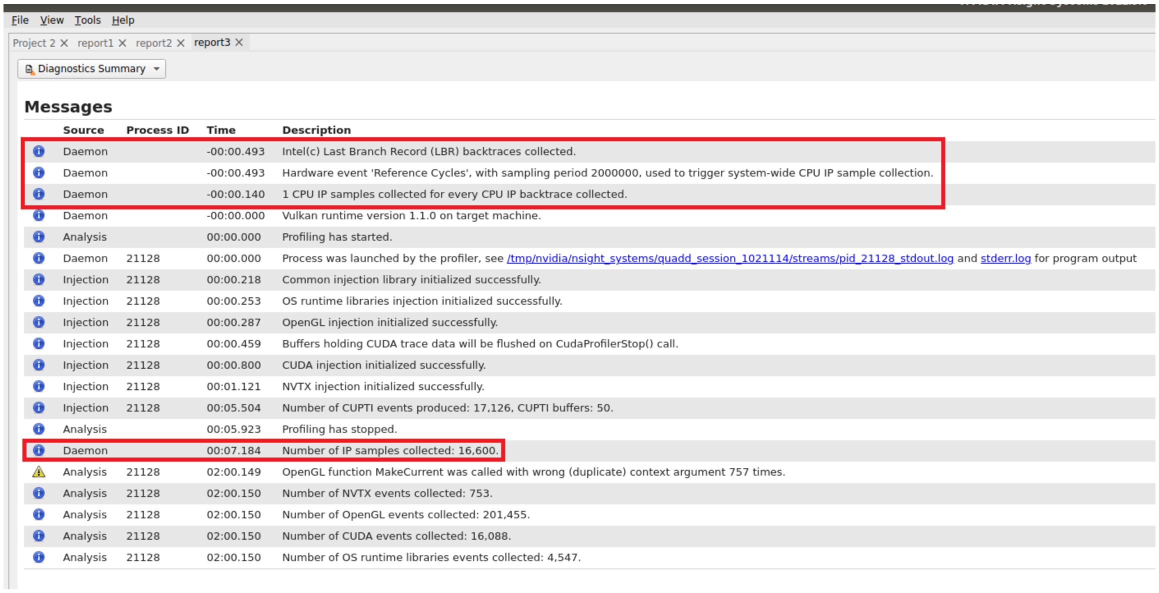
The configuration used during CPU profiling is documented in the Analysis Summary:



Analysis options

Collect CPU IP samples	On
Sampling period	2,000,000 events/sample
CPU IP Sampling Trigger Event	Reference Cycles
CPU IP samples / backtrace	3
CPU profiling scope	process-tree
Collect CPU context switch trace	On
Collect backtraces	On
Backtracing algorithm	Use Intel © Last Branch Record (LBR)
Include child processes	On

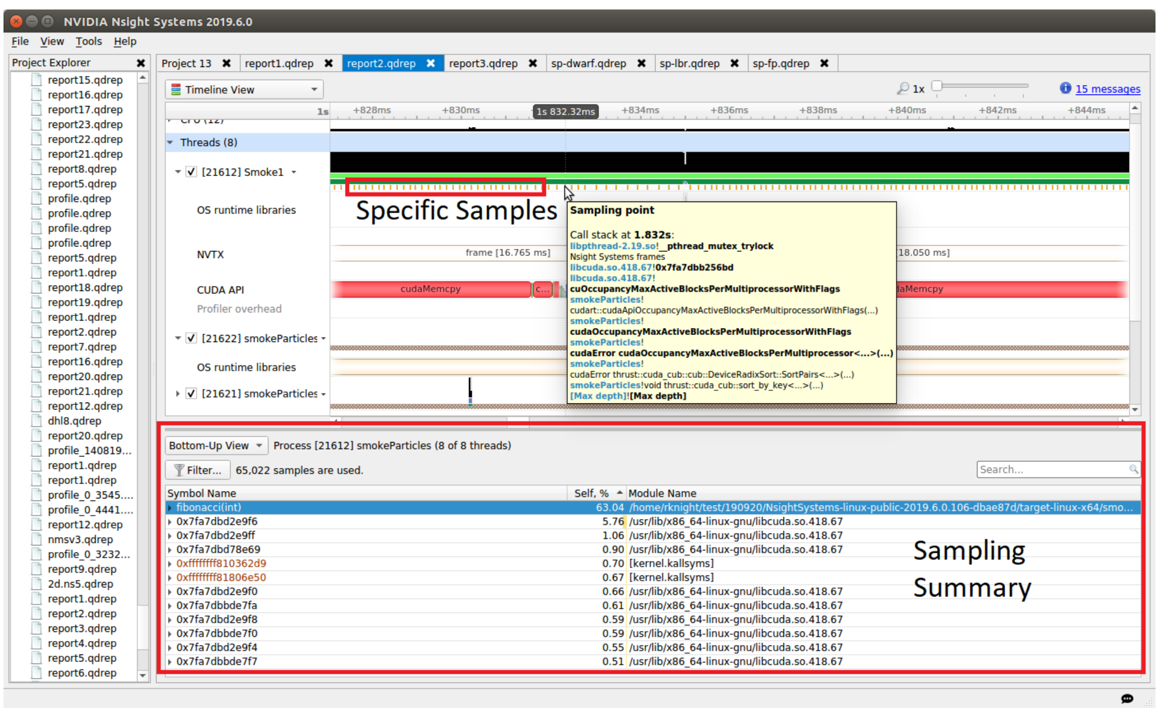
As well as in the Diagnosics Summary:



Visualizing CPU Profiling Results

Here are example screenshots visualizing CPU profiling results. For details about navigating the Timeline View and the backtraces, see the section on Timeline View in the Reading Your Report in the GUI section of the User Guide.

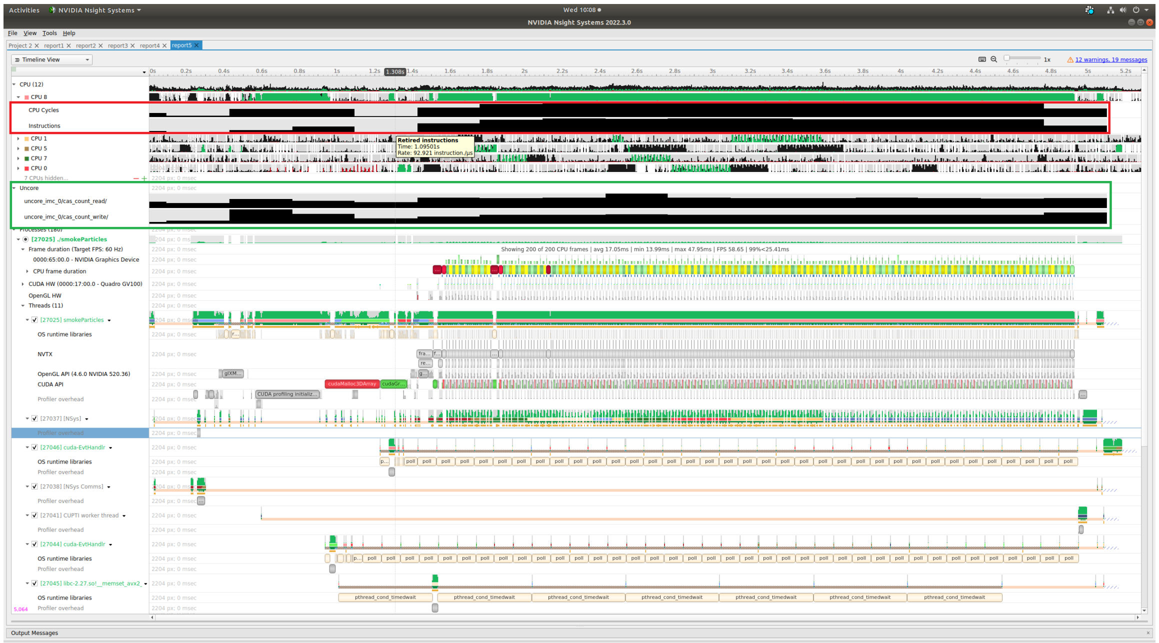
Example of CPU IP/Backtrace Data



In the timeline, yellow-orange marks can be found under each thread's timeline that indicate the moment an IP / backtrace sample was collected on that thread (e.g. see the yellow-orange marks in the Specific Samples box above). Hovering the cursor over a mark will cause a tooltip to display the backtrace for that sample.

Below the Timeline is a drop-down list with multiple options including Events View, Top-Down View, Bottom-Up View, and Flat View. All four of these views can be used to view CPU IP / back trace sampling data.

Example of Event Sampling



Event sampling samples hardware or software event counts during a collection and then graphs those events as rates on the Timeline. The above screenshot shows 4 hardware events. Core and cache events are graphed under the associated CPU row (see the red box in the screenshot) while uncore and OS events are graphed in their own row (see the green box in the screenshot). Hovering the cursor over an event sampling row in the timeline shows the event's rate at that moment.

Common Issues

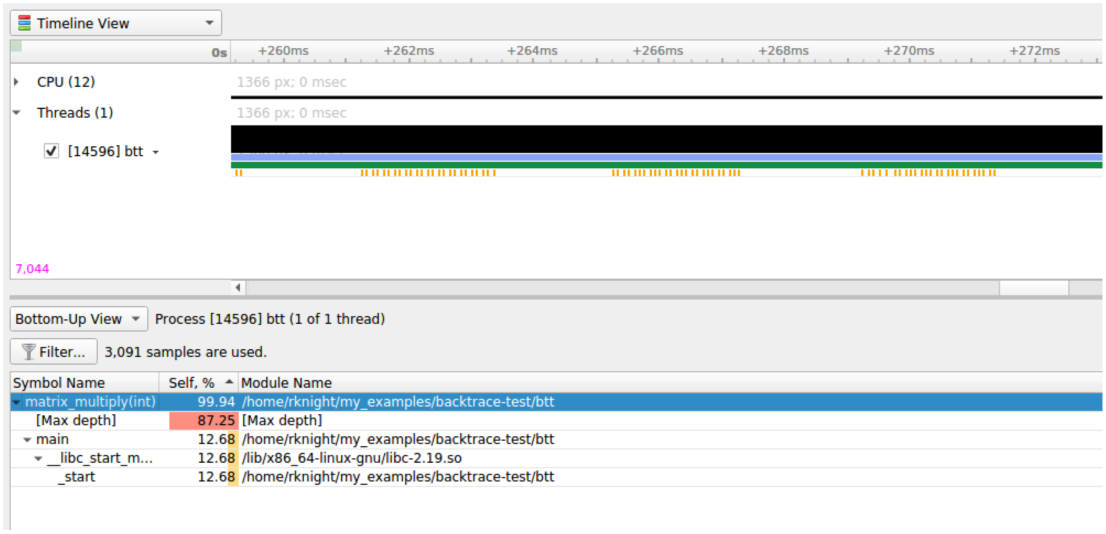
- **Reducing Overhead Caused By Sampling**

  There are several ways to reduce overhead caused by sampling.

  - disable sampling (i.e. use the **`--sampling=none`** switch)
  - increase the sampling period (i.e. reduce the sampling rate) using the **`--sampling-period`** switch
  - stop collecting backtraces (i.e. use the **`--backtrace=none`** switch) or collect more efficient backtraces - if available, use the **`--backtrace=lbr`** switch.
  - reduce the number of backtraces collected per sample. See documentation for the **`--samples-per-backtrace`** switch.

- **Throttling**

  The Linux operating system enforces a maximum time to handle sampling interrupts. This means that if collecting samples takes more than a specified amount of time, the OS will throttle (i.e slow down) the sampling rate to prevent the perf subsystem from causing too much overhead. When this occurs, sampling data may become irregular even though the thread is very busy.



The above screenshot shows a case where CPU IP / backtrace sampling was throttled during a collection. Note the irregular intervals of sampling tickmarks on the thread timeline. The number of times a collection throttled is provided in the Nsight Systems GUI's Diagnostics messages. If a collection throttles frequently (e.g. 1000s of times), increasing the sampling period should help reduce throttling.

Note: When throttling occurs, the OS sets a new (lower) maximum sampling rate in the procfs. This value must be reset before the sampling rate can be increased again. Use

	the following command to reset the OS' max sampling rate **`echo '100000' | sudo tee /proc/sys/kernel/perf_event_max_sample_rate`**

- **Sample intervals are irregular**

  My samples are not periodic - why? My samples are clumped up - why? There are gaps in between the samples - why? Likely reasons:

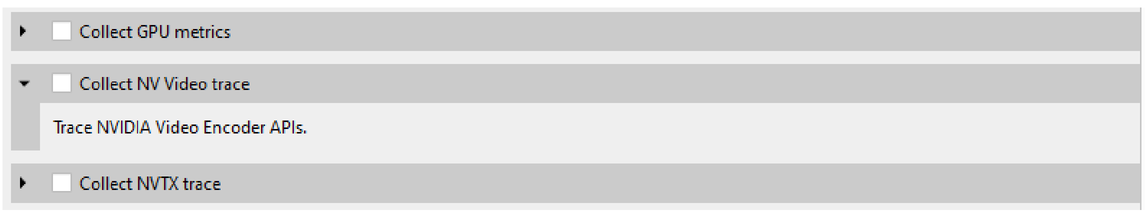
  - Throttling, as described above
  - The paranoid level is set to 2. If the paranoid level is set to 2, anytime the workload makes a system call and spends time executing kernel mode code, samples will not be collected and there will be gaps in the sampling data.
  - The sampling trigger itself is not periodic. If the trigger event is not periodic, for example, the Instructions Retired. event, sample collection will primarily occur when cache misses are occurring.
- **No CPU profiling data is collected**

  There are a few common issues that cause CPU profiling data to not be collected

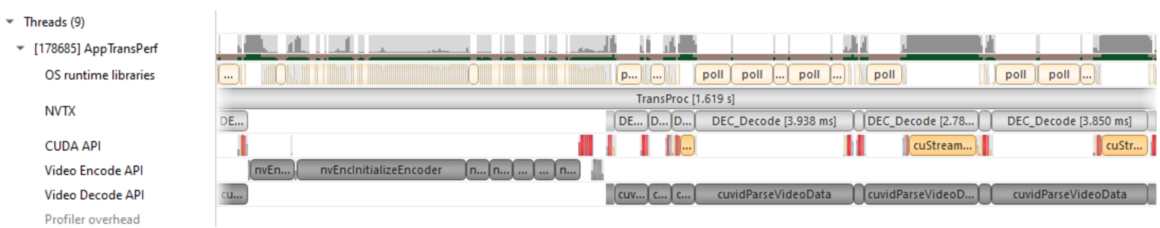
  - System requirements are not met. Check your system settings with the **`nsys status --environment`** command and see the System Requirements section above.
  - I profiled my workload in a Docker container but no sampling data was collected. By default, Docker containers prevent the perf_event_open syscall from being utilized. To override this behavior, launch the Docker with the **`--privileged`** switch or modify the Docker's seccompsettings.
  - I profiled my workload in a Docker container running Ubuntu 20+ running on top of a host system running CentOS with a kernel version < 3.10.0-693. The **`nsys status --environment`** command indicated that CPU profiling was supported. The host OS kernel version determines if CPU profiling is allowed and a CentOS host with a version < 3.10.0-693 is too old. In this case, the **`nsys status --environment`** command is incorrect.

Chapter 21. NVIDIA VIDEO CODEC SDK TRACE

Nsight Systems for x86 Linux and Windows targets can trace calls from the NV Video Codec SDK. This software trace can be launched from the GUI or using the **`--trace nvvideo`** from the CLI



On the timeline, calls on the CPU to the NV Encoder API and NV Decoder API will be shown.



21.1. NV Encoder API Functions Traced by Default

```
NvEncodeAPICreateInstance
nvEncOpenEncodeSession
nvEncGetEncodeGUIDCount
nvEncGetEncodeGUIDs
nvEncGetEncodeProfileGUIDCount
nvEncGetEncodeProfileGUIDs
nvEncGetInputFormatCount
nvEncGetInputFormats
nvEncGetEncodeCaps
nvEncGetEncodePresetCount
nvEncGetEncodePresetGUIDs
nvEncGetEncodePresetConfig
nvEncGetEncodePresetConfigEx
nvEncInitializeEncoder
nvEncCreateInputBuffer
nvEncDestroyInputBuffer
nvEncCreateBitstreamBuffer
nvEncDestroyBitstreamBuffer
nvEncEncodePicture
nvEncLockBitstream
nvEncUnlockBitstream
nvEncLockInputBuffer
nvEncUnlockInputBuffer
nvEncGetEncodeStats
nvEndGetSequenceParams
nvEncRegisterAsyncEvent
nvEncUnregisterAsyncEvent
nvEncMapInputResource
nvEncUnmapInputResource
nvEncDestroyEncoder
nvEncInvalidateRefFrames
nvEncOpenEncodeSessionEx
nvEncRegisterResource
nvEncUnregisterResource
nvEncReconfigureEncoder
nvEncCreateMVBuffer
nvEncDestroyMVBuffer
nvEncRunMotionEstimationOnly
nvEncGetLastErrorString
nvEncSetIOCudaStreams
nvEncGetSequenceParamEx
```

21.2. NV Decoder API Functions Traced by Default

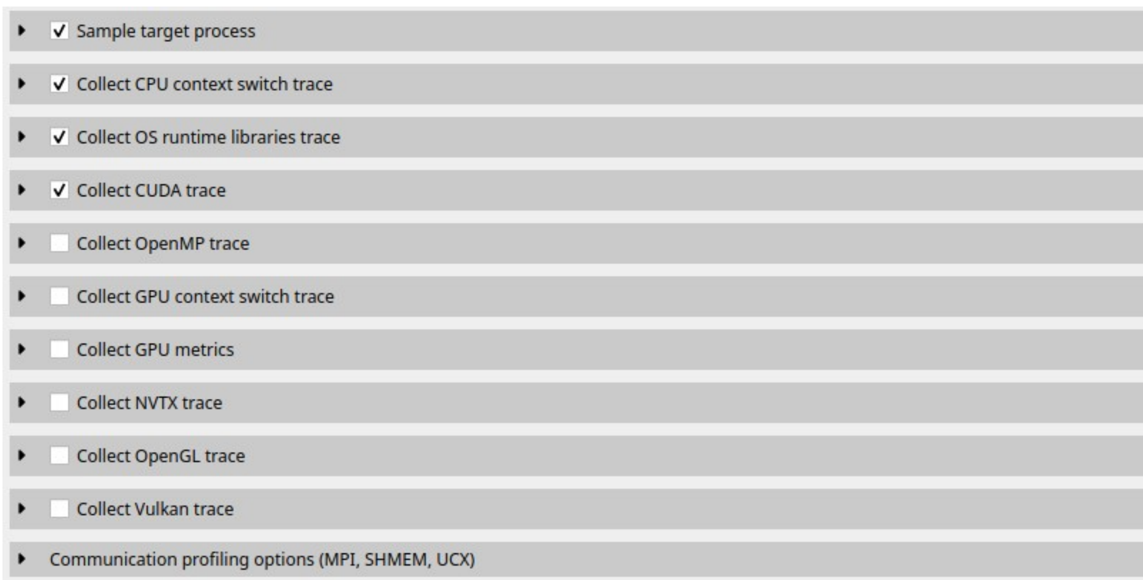
```
cuvidCreateVideoSource
cuvidCreateVideoSourceW
cuvidDestroyVideoSource
cuvidSetVideoSourceState
cudaVideoState
cuvidGetSourceVideoFormat
cuvidGetSourceAudioFormat
cuvidCreateVideoParser
cuvidParseVideoData
cuvidDestroyVideoParser
cuvidCreateDecoder
cuvidDestroyDecoder
cuvidDecodePicture
cuvidGetDecodeStatus
cuvidReconfigureDecoder
cuvidMapVideoFrame
cuvidUnmapVideoFrame
cuvidMapVideoFrame64
cuvidUnmapVideoFrame64
cuvidCtxLockCreate
cuvidCtxLockDestroy
cuvidCtxLock
cuvidCtxUnlock
```

21.3. NV JPEG API Functions Traced by Default

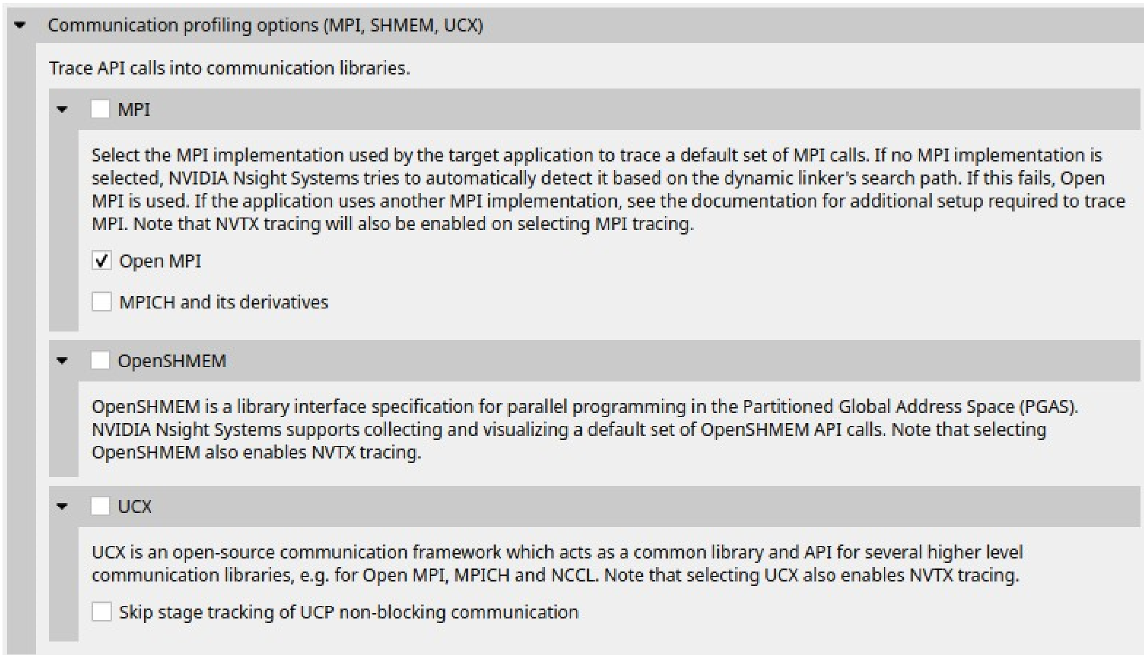
```
nvjpegBufferDeviceCreate
nvjpegBufferDeviceDestroy
nvjpegBufferDeviceRetrieve
nvjpegBufferPinnedCreate
nvjpegBufferPinnedDestroy
nvjpegBufferPinnedRetrieve
nvjpegCreate
nvjpegCreateEx
nvjpegCreateSimple
nvjpegDecode
nvjpegDecodeBatched
nvjpegDecodeBatchedEx
nvjpegDecodeBatchedInitialize
nvjpegDecodeBatchedPreAllocate
nvjpegDecodeBatchedSupported
nvjpegDecodeBatchedSupportedEx
nvjpegDecodeJpeg
nvjpegDecodeJpegDevice
nvjpegDecodeJpegHost
nvjpegDecodeJpegTransferToDevice
nvjpegDecodeParamsCreate
nvjpegDecodeParamsDestroy
nvjpegDecodeParamsSetAllowCMYK
nvjpegDecodeParamsSetOutputFormat
nvjpegDecodeParamsSetROI
nvjpegDecodeParamsSetScaleFactor
nvjpegDecoderCreate
nvjpegDecoderDestroy
nvjpegDecoderJpegSupported
nvjpegDecoderStateCreate
nvjpegDestroy
nvjpegEncodeGetBufferSize
nvjpegEncodeImage
nvjpegEncodeRetrieveBitstream
nvjpegEncodeRetrieveBitstreamDevice
nvjpegEncoderParamsCopyHuffmanTables
nvjpegEncoderParamsCopyMetadata
nvjpegEncoderParamsCopyQuantizationTables
nvjpegEncoderParamsCreate
nvjpegEncoderParamsDestroy
nvjpegEncoderParamsSetEncoding
nvjpegEncoderParamsSetOptimizedHuffman
nvjpegEncoderParamsSetQuality
nvjpegEncoderParamsSetSamplingFactors
nvjpegEncoderStateCreate
nvjpegEncoderStateDestroy
nvjpegEncodeYUV,(nvjpegHandle_t handle
nvjpegGetCudartProperty
nvjpegGetDeviceMemoryPadding
nvjpegGetImageInfo
nvjpegGetPinnedMemoryPadding
nvjpegGetProperty
nvjpegJpegStateCreate
nvjpegJpegStateDestroy
nvjpegJpegStreamCreate
nvjpegJpegStreamDestroy
nvjpegJpegStreamGetChromaSubsampling
nvjpegJpegStreamGetComponentDimensions
nvjpegJpegStreamGetComponentsNum
nvjpegJpegStreamGetFrameDimensions
nvjpegJpegStreamGetJpegEncoding
nvjpegJpegStreamParse
nvjpegJpegStreamParseHeader
nvjpegSetDeviceMemoryPadding
nvjpegSetPinnedMemoryPadding
nvjpegStateAttachDeviceBuffer
nvjpegStateAttachPinnedBuffer
```

Chapter 22. NETWORK COMMUNICATION PROFILING

Nsight Systems can be used to profiles several popular network communication protocols. To enable this, please select the **Communication profiling options** dropdown.

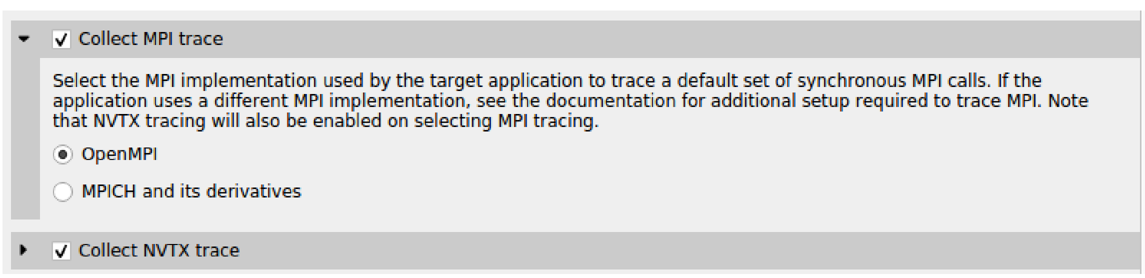


Then select the libraries you would like to trace:

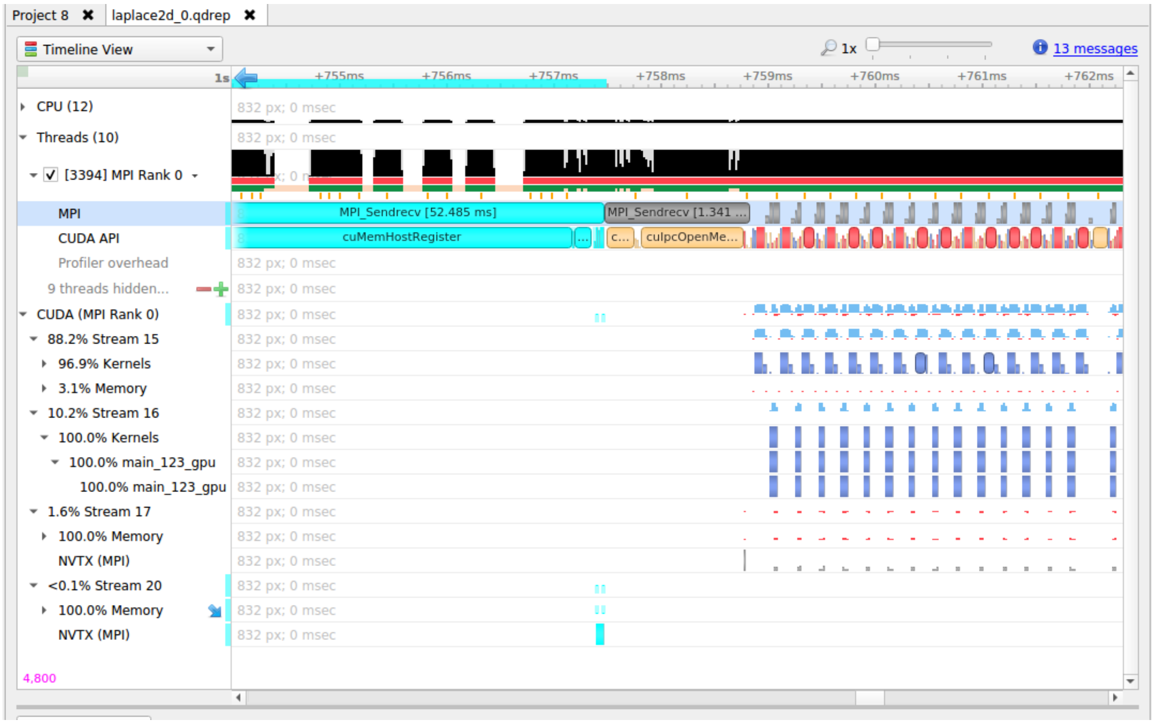


22.1. MPI API Trace

For Linux x86_64, ARM and Power targets, Nsight Systems is capable of capturing information about the MPI APIs executed in the profiled process. It has built-in API trace support for Open MPI and MPICH based MPI implementations.



Only a subset of the MPI API, including blocking and non-blocking point-to-point and collective communication, and file I/O operations, is traced. If you require more control over the list of traced APIs or if you are using a different MPI implementation, you can use the NVTX wrappers for MPI. If you set the environment variable **`LD_PRELOAD`** to the path of generated wrapper library, Nsight Systems will capture and report the MPI API trace information when NVTX tracing is enabled. Choose an NVTX domain name other than "MPI", since it is filtered out by Nsight Systems when MPI tracing is not enabled.



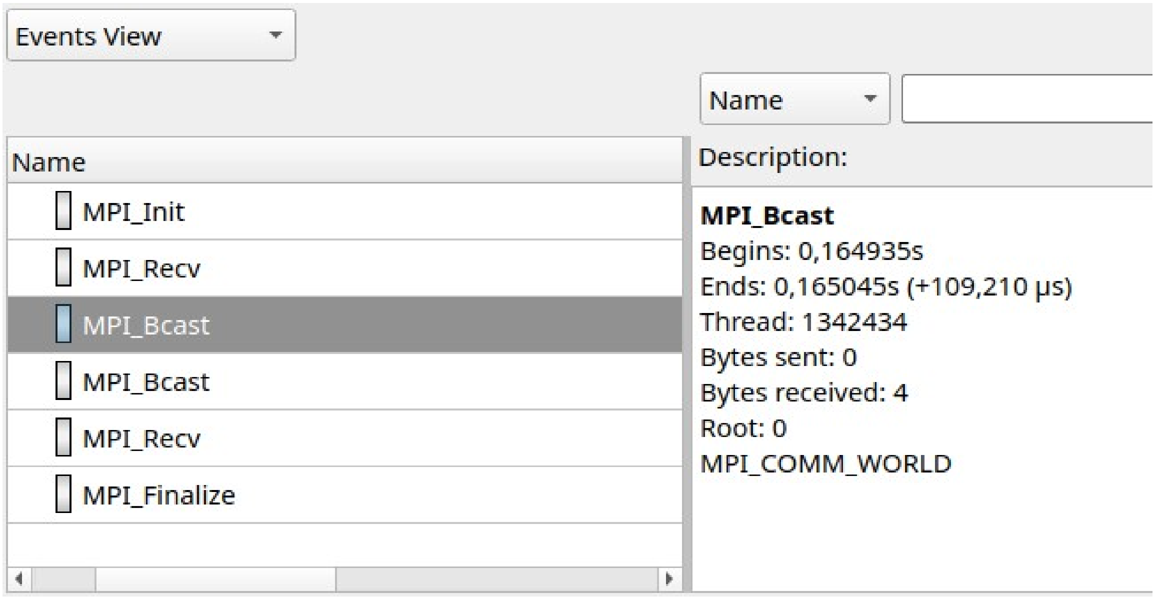
MPI Communication Parameters

Nsight Systems can get additional information about MPI communication parameters. Currently, the parameters are only visible in the mouseover tooltips or in the eventlog. This means that the data is only available via the GUI. Future versions of the tool will export this information into the SQLite data files for postrun analysis.

In order to fully interpret MPI communications, data for all ranks associated with a communication operation must be loaded into Nsight Systems.

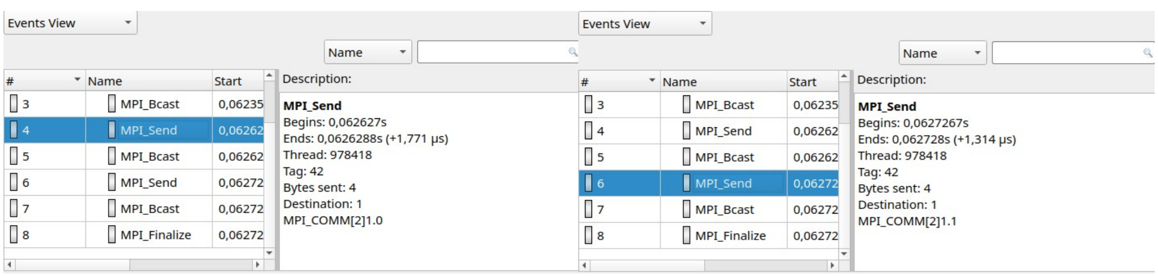
Here is an example of MPI_COMM_WORLD data. This does not require any additional team data, since local rank is the same as global rank.

(Screenshot shows communication parameters for an MPI_Bcast call on rank 3)



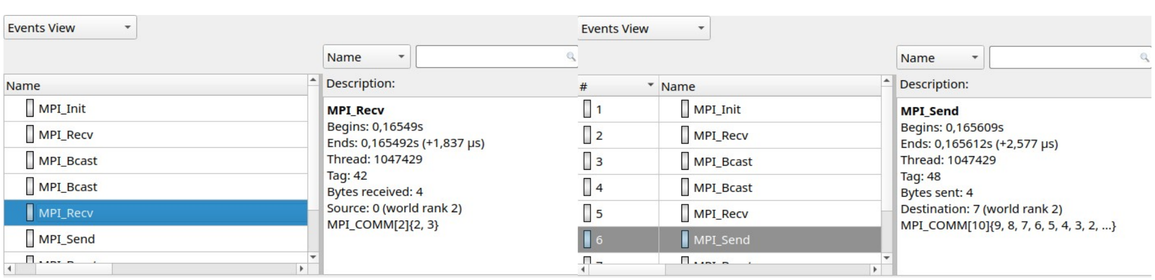
When not all processes that are involved in an MPI communication are loaded into Nsight Systems the following information is available.

- Right-hand screenshot shows a reused communicator handle (last number increased).
- Encoding: MPI_COMM[*team size*]*global-group-root-rank*.*group-ID*



When all reports are loaded into Nsight Systems:

- World rank is shown in addition to group-local rank "(world rank X)"
- Encoding: MPI_COMM[*team size*]{rank0, rank1, ...}
- At most 8 ranks are shown (the numbers represent world ranks, the position in the list is the group-local rank)



MPI functions traced:

```
MPI_Init[_thread], MPI_Finalize
MPI_Send, MPI_{B,S,R}send, MPI_Recv, MPI_Mrecv
MPI_Sendrecv[_replace]

MPI_Barrier, MPI_Bcast
MPI_Scatter[v], MPI_Gather[v]
MPI_Allgather[v], MPI_Alltoall[{v,w}]
MPI_Allreduce, MPI_Reduce[_{scatter,scatter_block,local}]
MPI_Scan, MPI_Exscan

MPI_Isend, MPI_I{b,s,r}send, MPI_I[m]recv
MPI_{Send,Bsend,Ssend,Rsend,Recv}_init
MPI_Start[all]
MPI_Ibarrier, MPI_Ibcast
MPI_Iscatter[v], MPI_Igather[v]
MPI_Iallgather[v], MPI_Ialltoall[{v,w}]
MPI_Iallreduce, MPI_Ireduce[{scatter,scatter_block}]
MPI_I[ex]scan
MPI_Wait[{all,any,some}]

MPI_Put, MPI_Rput, MPI_Get, MPI_Rget
MPI_Accumulate, MPI_Raccumulate
MPI_Get_accumulate, MPI_Rget_accumulate
MPI_Fetch_and_op, MPI_Compare_and_swap

MPI_Win_allocate[_shared]
MPI_Win_create[_dynamic]
MPI_Win_{attach, detach}
MPI_Win_free
MPI_Win_fence
MPI_Win_{start, complete, post, wait}
MPI_Win_[un]lock[_all]
MPI_Win_flush[_local][_all]
MPI_Win_sync

MPI_File_{open,close,delete,sync}
MPI_File_{read,write}[_{all,all_begin,all_end}]
MPI_File_{read,write}_at[_{all,all_begin,all_end}]
MPI_File_{read,write}_shared
MPI_File_{read,write}_ordered[_{begin,end}]
MPI_File_i{read,write}[_{all,at,at_all,shared}]
MPI_File_set_{size,view,info}
MPI_File_get_{size,view,info,group,amode}
MPI_File_preallocate

MPI_Pack[_external]
MPI_Unpack[_external]
```

22.2. OpenSHMEM Library Trace

If OpenSHMEM library trace is selected Nsight Systems will trace the subset of OpenSHMEM API functions that are most likely be involved in performance bottlenecks. To keep overhead low Nsight Systems does not trace all functions.

OpenSHMEM 1.5 Functions Not Traced

```
shmem_my_pe
shmem_n_pes
shmem_global_exit
shmem_pe_accessible
shmem_addr_accessible
shmem_ctx_{create,destroy,get_team}
shmem_global_exit
shmem_info_get_{version,name}
shmem_{my_pe,n_pes,pe_accessible,ptr}
shmem_query_thread
shmem_team_{create_ctx,destroy}
shmem_team_get_config
shmem_team_{my_pe,n_pes,translate_pe}
shmem_team_split_{2d,strided}
shmem_test*
```

22.3. UCX Library Trace

If UCX library trace is selected Nsight Systems will trace the subset of functions of the UCX protocol layer UCP that are most likely be involved in performance bottlenecks. To keep overhead low Nsight Systems does not trace all functions.

UCX functions traced:

```
ucp_am_send_nb[x]
ucp_am_recv_data_nbx
ucp_am_data_release
ucp_atomic_{add{32,64},cswap{32,64},fadd{32,64},swap{32,64}}
ucp_atomic_{post,fetch_nb,op_nbx}
ucp_cleanup
ucp_config_{modify,read,release}
ucp_disconnect_nb
ucp_dt_{create_generic,destroy}
ucp_ep_{create,destroy,modify_nb,close_nbx}
ucp_ep_flush[{_nb,_nbx}]
ucp_listener_{create,destroy,query,reject}
ucp_mem_{advise,map,unmap,query}
ucp_{put,get}[_nbi]
ucp_{put,get}_nb[x]
ucp_request_{alloc,cancel,is_completed}
ucp_rkey_{buffer_release,destroy,pack,ptr}
ucp_stream_data_release
ucp_stream_recv_data_nb
ucp_stream_{send,recv}_nb[x]
ucp_stream_worker_poll
ucp_tag_msg_recv_nb[x]
ucp_tag_{send,recv}_nbr
ucp_tag_{send,recv}_nb[x]
ucp_tag_send_sync_nb[x]
ucp_worker_{create,destroy,get_address,get_efd,arm,fence,wait,signal,wait_mem}
ucp_worker_flush[{_nb,_nbx}]
ucp_worker_set_am_{handler,recv_handler}
```

UCX Functions Not Traced:

```
ucp_config_print
ucp_conn_request_query
ucp_context_{query,print_info}
ucp_get_version[_string]
ucp_ep_{close_nb,print_info,query,rkey_unpack}
ucp_mem_print_info
ucp_request_{check_status,free,query,release,test}
ucp_stream_recv_request_test
ucp_tag_probe_nb
ucp_tag_recv_request_test
ucp_worker_{address_query,print_info,progress,query,release_address}
```

Additional API functions from other UCX layers may be added in a future version of the product.

22.4. NVIDIA NVSHMEM and NCCL Trace

The NVIDIA network communication libraries NVSHMEM and NCCL have been instrumented using NVTX annotations. To enable tracing these libraries in Nsight Systems, turn on NVTX tracing in the GUI or CLI. To enable the NVTX instrumentation of the NVSHMEM library, make sure that the environment variable **`NVSHMEM_NVTX`** is set properly, e.g. **`NVSHMEM_NVTX=common`**.

22.5. NIC Metric Sampling

Overview

NVIDIA ConnectX smart network interface cards (smart NICs) offer advanced hardware offloads and accelerations for network operations. Viewing smart NICs metrics, on Nsight Systems timeline, enables developers to better understand their application's network usage. Developers can use this information to optimize the application's performance.

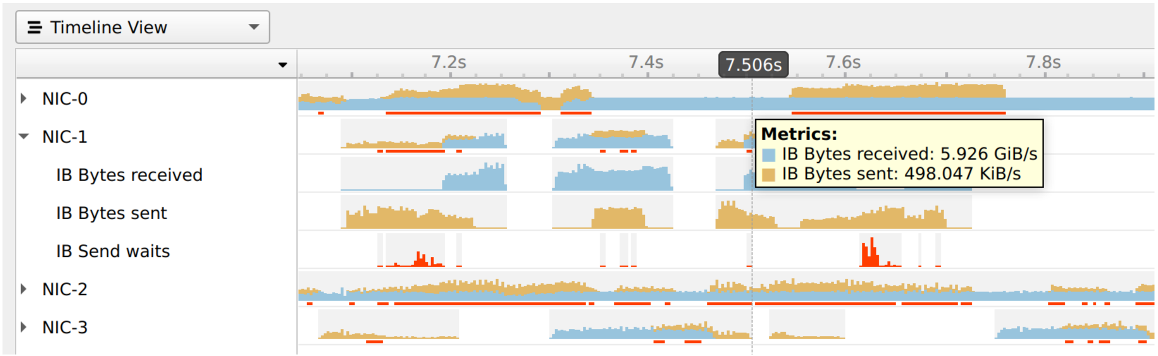
Limitations/Requirements

- NIC metric sampling supports NVIDIA ConnectX boards starting with ConnectX 5
- NIC metric sampling supported on Linux x86_64 machines only, having minimum Linux kernel 4.12 and minimum MLNX_OFED 4.1.
- NIC metric sampling is only available from the command line

Collecting NIC Metrics Using the Command Line

To collect NIC performance metric, using Nsight Systems CLI, add the **`--nic-metrics`** command line switch:

```
nsys profile --nic-metrics=true my_app
```



Available Metrics

- **Bytes sent** - Number of bytes sent through all NIC ports.
- **Bytes received** - Number of bytes received by all NIC ports.
- **CNPs sent** - Number of congestion notification packets sent by the NIC.
- **CNPs received** - Number of congestion notification packets received and handled by the NIC.
- **Send waits** - The number of ticks during which ports had data to transmit but no data was sent during the entire tick (either because of insufficient credits or because of lack of arbitration)

Note: Each one of the mentioned metrics is shown only if it has non-zero value during profiling.

Usage Examples

- The **`Bytes sent/sec`** and the **`Bytes received/sec`** metrics enables identifying idle and busy NIC times.
  - Developers may shift network operations from busy to idle times to reduce network congestion and latency.
  - Developers can use idle NIC times to send additional data without reducing application performance.
- CNPs (congestion notification packets) received/sent and Send waits metrics may explain network latencies. A developer seeing the time periods when the network was congested may rewrite his algorithm to avoid the observed congestions.

Note: RDMA over Converged Ethernet (RoCE) traffic is not logged into the Nsight Systems NIC metrics.

22.6. InfiniBand Switch Metric Sampling

NVIDIA Quantum InfiniBand switches offer high-bandwidth, low-latency communication. Viewing switch metrics, on Nsight Systems timeline, enables developers to better understand their application's network usage. Developers can use this information to optimize the application's performance.

Limitations/Requirements

IB switch metric sampling supports all NVIDIA Quantum switches. The user needs to have permission to query the InfiniBand switch metrics.

To check if the current user has permissions to query the InfiniBand switch metrics, check that the user have permission to access /dev/umad

To give user permissions to query InfiniBand switch metrics on RedHat systems, follow the directions at RedHat Solutions.

To collect InfiniBand switch performance metric, using Nsight Systems CLI, add the **`--ib-switch-metrics`** command line switch, followed by a comma separated list of InfiniBand switch GUIDs. For example:

```
nsys profile --ib-switch-metrics=<IB switch GUID> my_app
```

To get a list of InfiniBand switches connected to the machine, use:

```
sudo ibnetdiscover -S
```

Available Metrics

- Bytes sent - Number of bytes sent through all switch ports
- Bytes received - Number of bytes received by all switch ports

Chapter 23. READING YOUR REPORT IN GUI

23.1. Generating a New Report

Users can generate a new report by stopping a profiling session. If a profiling session has been canceled, a report will not be generated, and all collected data will be discarded.

A new **`.nsys-rep`** file will be created and put into the same directory as the project file (**`.qdproj`**).

23.2. Opening an Existing Report

An existing **`.nsys-rep`** file can be opened using **File > Open...**.

23.3. Sharing a Report File

Report files (**`.nsys-rep`**) are self-contained and can be shared with other users of Nsight Systems. The only requirement is that the same or newer version of Nsight Systems is always used to open report files.

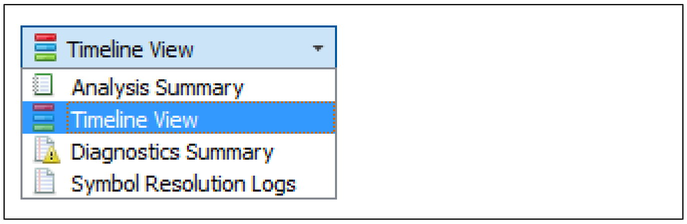
Project files (**`.qdproj`**) are currently not shareable, since they contain full paths to the report files.

To quickly navigate to the directory containing the report file, right click on it in the Project Explorer, and choose **Show in folder...** in the context menu.

23.4. Report Tab

While generating a new report or loading an existing one, a new tab will be created. The most important parts of the report tab are:

- **View selector** — Allows switching between *Analysis Summary*, *Timeline View*, *Diagnostics Summary*, and *Symbol Resolution Logs* views.



- **Timeline** — This is where all charts are displayed.
- **Function table** — Located below the timeline, it displays statistical information about functions in the target application in multiple ways.

Additionally, the following controls are available:

- **Zoom slider** — Allows you to vertically zoom the charts on the timeline.

23.5. Analysis Summary View

This view shows a summary of the profiling session. In particular, it is useful to review the project configuration used to generate this report. Information from this view can be selected and copied using the mouse cursor.

23.6. Timeline View

The timeline view consists of two main controls: the timeline at the top, and a bottom pane that contains the events view and the function table. In some cases, when sampling of a process has not been enabled, the function table might be empty and hidden.

The bottom view selector sets the view that is displayed in the bottom pane.

23.6.1. Timeline

Timeline is a versatile control that contains a tree-like **hierarchy** on the left, and corresponding *charts* on the right.

Contents of the hierarchy depend on the project settings used to collect the report. For example, if a certain feature has not been enabled, corresponding rows will not be show on the timeline.

To generate a timeline screenshot without opening the full GUI, use the command

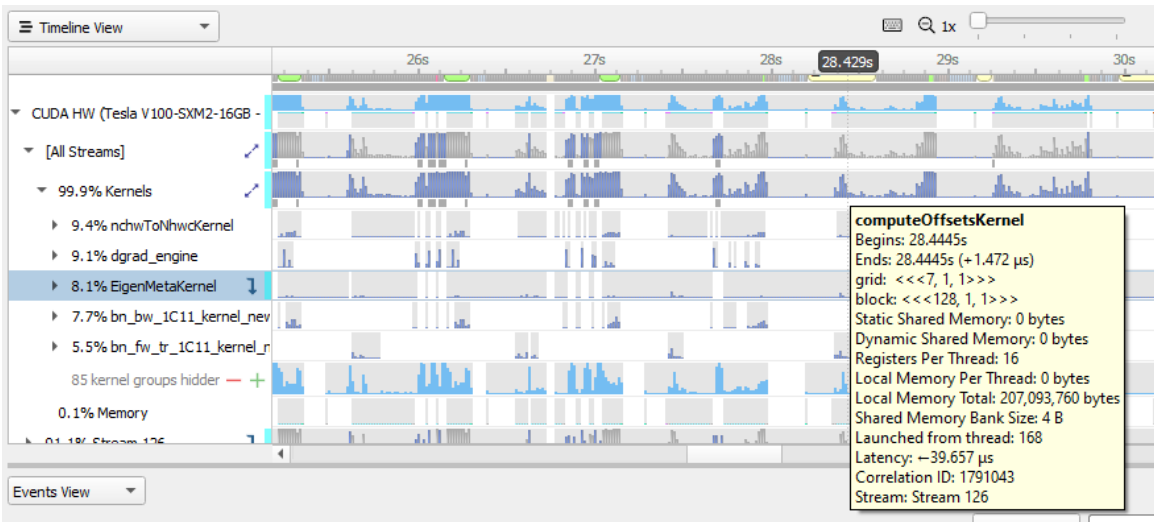
```
nsys-ui.exe --screenshot filename.nsys-rep
```

To display trace events in the Events View right-click a timeline row and select the "Show in Events View" command. The events of the selected row and all of its sub-rows will be displayed in the Events View.

If a timeline row has been selected for display in the Events View then double-clicking a timeline item on that row will automatically scroll the content of the Events View to make the corresponding Events View item visible and select it.

Row Height

Several of the rows in the timeline use height as a way to model the percent utilization of resources. This gives the user insight into what is going on even when the timeline is zoomed all the way out.



In this picture you see that for kernel occupation there is a colored bar of variable height.

Nsight Systems calculates the average occupancy for the period of time represented by particular pixel width of screen. It then uses that average to set the top of the colored section. So, for instance, if 25% of that timeslice the kernel is active, the bar goes 25% of the distance to the top of the row.

In order to make the difference clear, if the percentage of the row height is non-zero, but would be represented by less than one vertical pixel, Nsight Systems displays it as one pixel high. The gray height represents the maximum usage in that time range.

This row height coding is used in the CPU utilization, thread and process occupancy, kernel occupancy, and memory transfer activity rows.

23.6.2. Events View

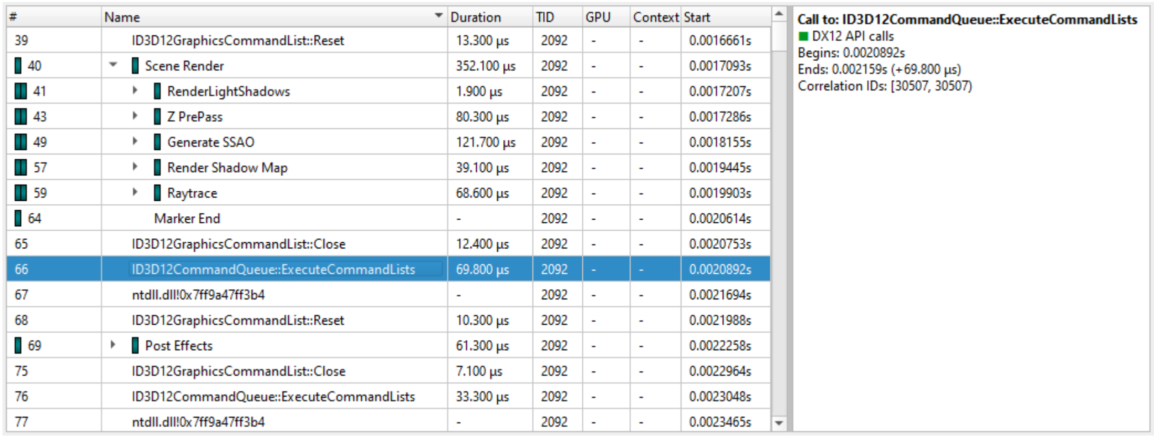
The Events View provides a tabular display of the trace events. The view contents can be searched and sorted.

Double-clicking an item in the Events View automatically focuses the Timeline View on the corresponding timeline item.

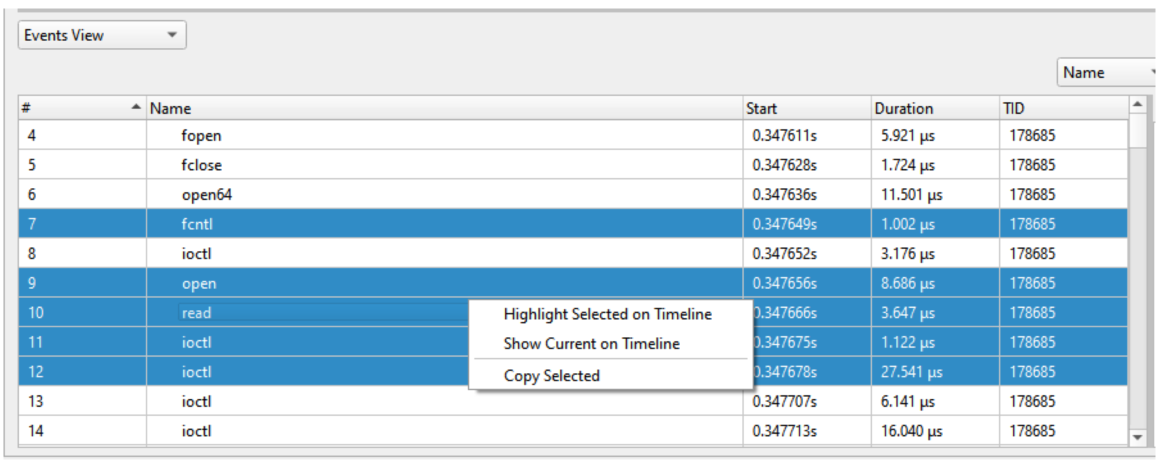
API calls, GPU executions, and debug markers that occurred within the boundaries of a debug marker are displayed nested to that debug marker. Multiple levels of nesting are supported.

Events view recognizes these types of debug markers:

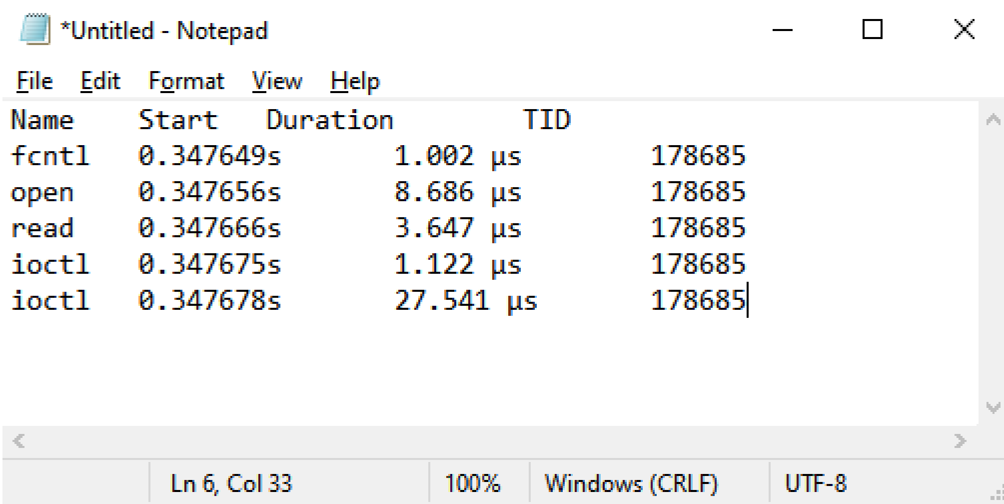
- NVTX
- Vulkan VK_EXT_debug_marker markers, VK_EXT_debug_utils labels
- PIX events and markers
- OpenGL KHR_debug markers



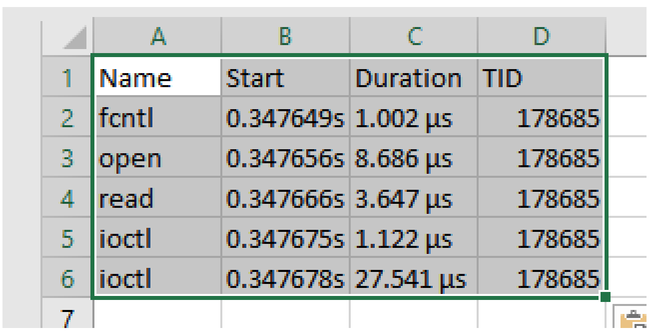
You can copy and paste from the events view by highlighting rows, using **Shift** or **Ctrl** to enable multi-select. Right clicking on the selection will give you a copy option.



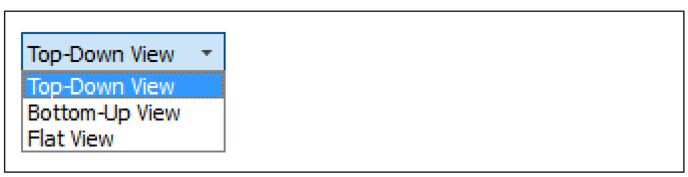
Pasting into text gives you a tab separated view:



Pasting into spreadsheet properly copies into rows and columns:



23.6.3. Function Table Modes



The function table can work in three modes:

- **Top-Down View** — In this mode, expanding top-level functions provides information about the *callee* functions. One of the top-level functions is typically the main function of your application, or another entry point defined by the runtime libraries.
- **Bottom-Up View** — This is a reverse of the Top-Down view. On the top level, there are functions directly hit by the sampling profiler. To explore all possible call chains leading to these functions, you need to expand the subtrees of the top-level functions.
- **Flat View** — This view enumerates all functions ever observed by the profiler, even if they have never been directly hit, but just appeared somewhere on the call stack. This view typically provides a high-level overview of which parts of the code are CPU-intensive.

Each of the views helps understand particular performance issues of the application being profiled. For example:

- When trying to find specific bottleneck functions that can be optimized, the Bottom-Up view should be used. Typically, the top few functions should be examined. Expand them to understand in which contexts they are being used.
- To navigate the call tree of the application and while generally searching for algorithms and parts of the code that consume unexpectedly large amount of CPU time, the Top-Down view should be used.
- To quickly assess which parts of the application, or high level parts of an algorithm, consume significant amount of CPU time, use the Flat view.

The Top-Down and Bottom-Up views have *Self* and *Total* columns, while the Flat view has a *Flat* column. It is important to understand the meaning of each of the columns:

- Top-Down view
  - **Self** column denotes the relative amount of time spent executing instructions of this particular function.
  - **Total** column shows how much time has been spent executing this function, including all other functions called from this one. Total values of sibling rows sum up to the Total value of the parent row, or 100% for the top-level rows.
- Bottom-Up view
  - **Self** column for *top-level rows*, as in the Top-Down view, shows how much time has been spent directly in this function. Self times of all top-level rows add up to 100%.
  - **Self** column for *children rows* breaks down the value of the parent row based on the various call chains leading to that function. Self times of sibling rows add up to the value of the parent row.
- Flat view
  - **Flat** column shows how much time this function has been anywhere on the call stack. Values in this column do not add up or have other significant relationships.

Note:	If low-impact functions have been filtered out, values may not add up correctly to 100%, or

	to the value of the parent row. This filtering can be disabled.

Contents of the symbols table is tightly related to the timeline. Users can apply and modify filters on the timeline, and they will affect which information is displayed in the symbols table:

- **Per-thread filtering** — Each thread that has sampling information associated with it has a checkbox next to it on the timeline. Only threads with selected checkboxes are represented in the symbols table.
- **Time filtering** — A time filter can be setup on the timeline by pressing the left mouse button, dragging over a region of interest on the timeline, and then choosing **Filter by selection** in the dropdown menu. In this case, only sampling information collected during the selected time range will be used to build the symbols table.

Note:	If too little sampling data is being used to build the symbols table (for example, when the sampling rate is configured to be low, and a short period of time is used

	for time-based filtering), the numbers in the symbols table might not be representative or accurate in some cases.

23.6.4. Function Table Notes

Last Branch Records vs Frame Pointers

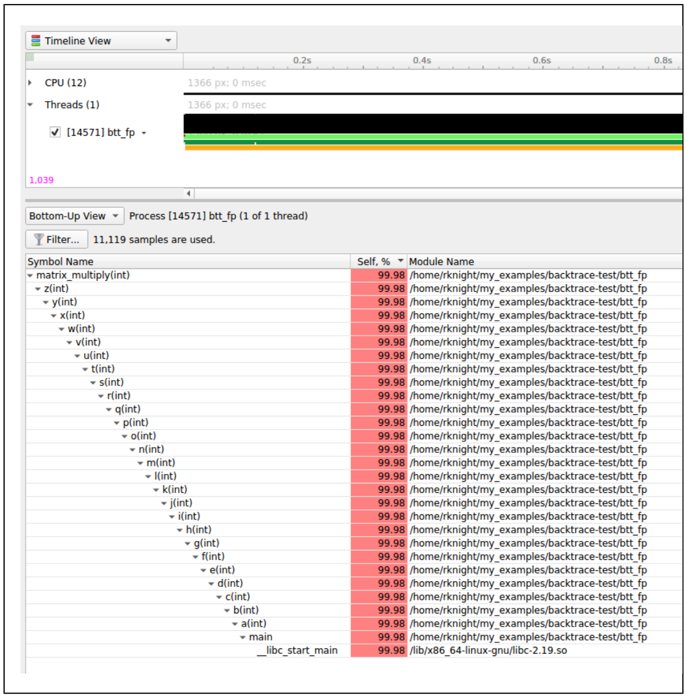
Two of the mechanisms available for collecting backtraces are Intel Last Branch Records (LBRs) and frame pointers. LBRs are used to trace every branch instruction via a limited set of hardware registers. They can be configured to generate backtraces but have finite depth based on the CPU's microarchitecture. LBRs are effectively free to collect but may not be as deep as you need in order to fully understand how the workload arrived a specific Instruction Pointer (IP).

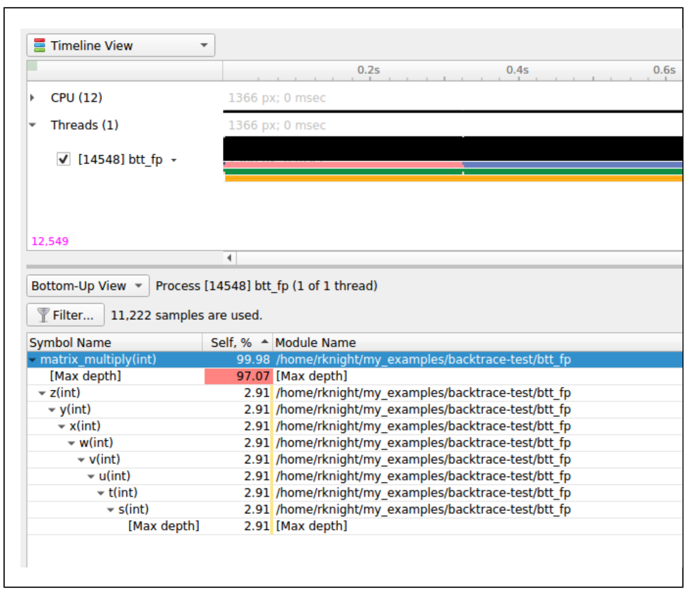
Frame pointers only work when a binary is compiled with the **`-fno-omit-frame-pointer`** compiler switch. To determine if frame pointers are enabled on an x86_64 binary running on Linux, dump a binary's assembly code using the **`objdump -d [binary_file]`** command and look for this pattern at the beginning of all functions;

```
push   %rbp
mov    %rsp,%rbp
```

When frame pointers are available in a binary, full stack traces will be captured. Note that libraries that are frequently used by apps and ship with the operating system, such as libc, are generated in release mode and therefore do not include frame pointers. Frequently, when a backtrace includes an address from a system library, the backtrace will fail to resolve further as the frame pointer trail goes cold due to a missing frame pointer.

A simple application was developed to show the difference. The application calls function a(), which calls b(), which calls c(), etc. Function z() calls a heavy compute function called matrix_multiply(). Almost all of the IP samples are collected while matrix_multiple is executing. The next two screen shots show one of the main differences between frame pointers and LBRs.





Note that the frame pointer example, shows the full stack trace while the LBR example, only shows part of the stack due to the limited number of LBR registers in the CPU.

Kernel Samples

When an IP sample is captured while a kernel mode (i.e. operating system) function is executing, the sample will be shown with an address that starts with 0xffffffff and map to the [kernel.kallsyms] module.

[vdso]

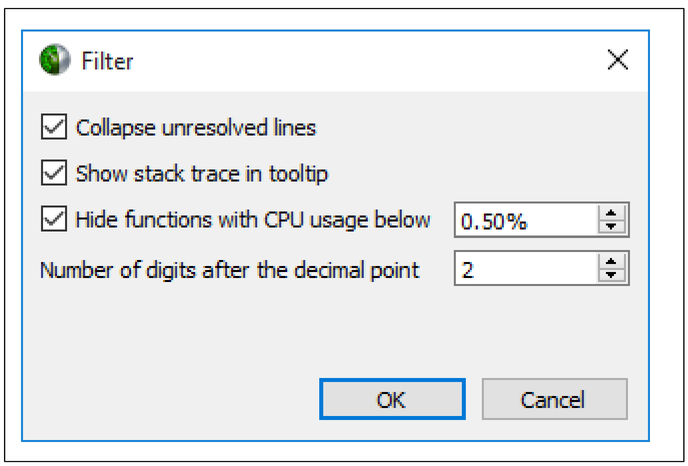
Samples may be collected while a CPU is executing functions in the Virtual Dynamic Shared Object. In this case, the sample will be resolved (i.e. mapped) to the [vdso] module. The vdso man page provides the following description of the vdso:

```
The "vDSO" (virtual dynamic shared object) is a small shared library
that the kernel automatically maps into the address space of all
user-space applications.  Applications usually do not need to concern
themselves with these details as the vDSO is most commonly called by
the C library.  This way you can code in the normal way using
standard functions and the C library will take care of using any
functionality that is available via the vDSO.

Why does the vDSO exist at all?  There are some system calls the
kernel provides that user-space code ends up using frequently, to the
point that such calls can dominate overall performance. This is due
both to the frequency of the call as well as the context-switch
overhead that results from exiting user space and entering the
kernel.
```

[Unknown]

When an address can not be resolved (i.e. mapped to a module), its address within the process' address space will be shown and its module will be marked as [Unknown].

23.6.5. Filter Dialog



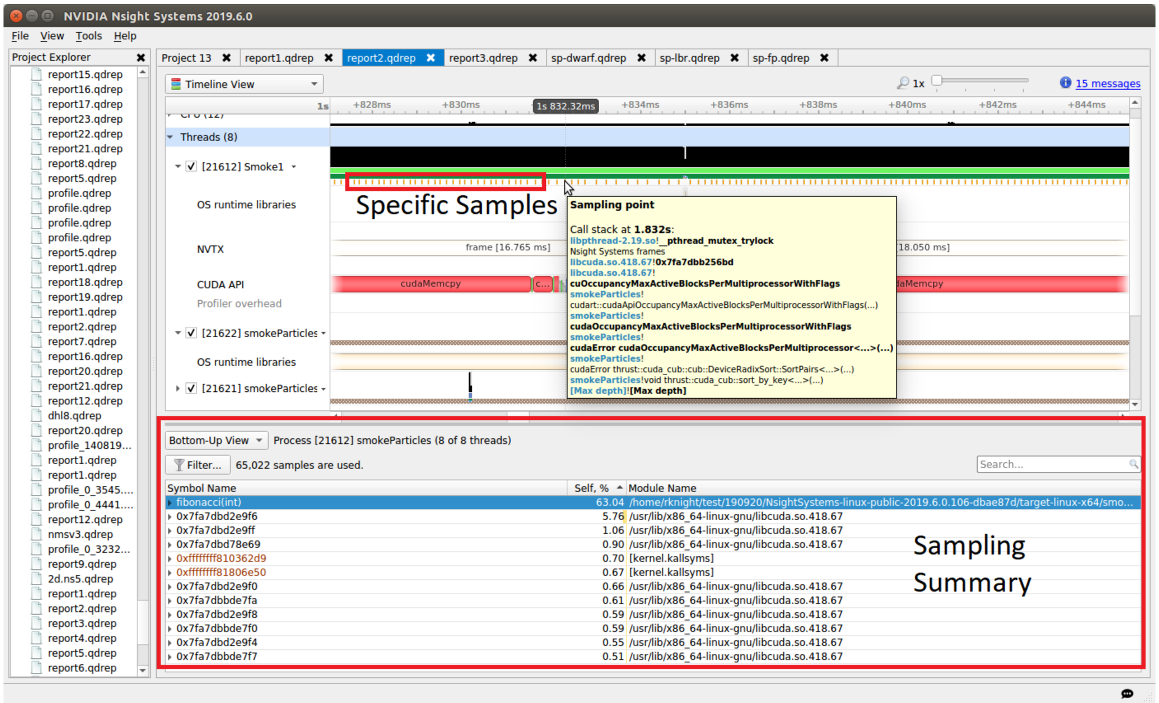
- **Collapse unresolved lines** is useful if some of the binary code does not have symbols. In this case, subtrees that consist of only unresolved symbols get collapsed in the Top-Down view, since they provide very little useful information.
- **Hide functions with CPU usage below X%** is useful for large applications, where the sampling profiler hits lots of function just a few times. To filter out the "long tail," which is typically not important for CPU performance bottleneck analysis, this checkbox should be selected.

23.6.6. Example of Using Timeline with Function Table

Here is an example walkthrough of using the timeline and function table with Instruction Pointer (IP)/backtrace Sampling Data

Timeline

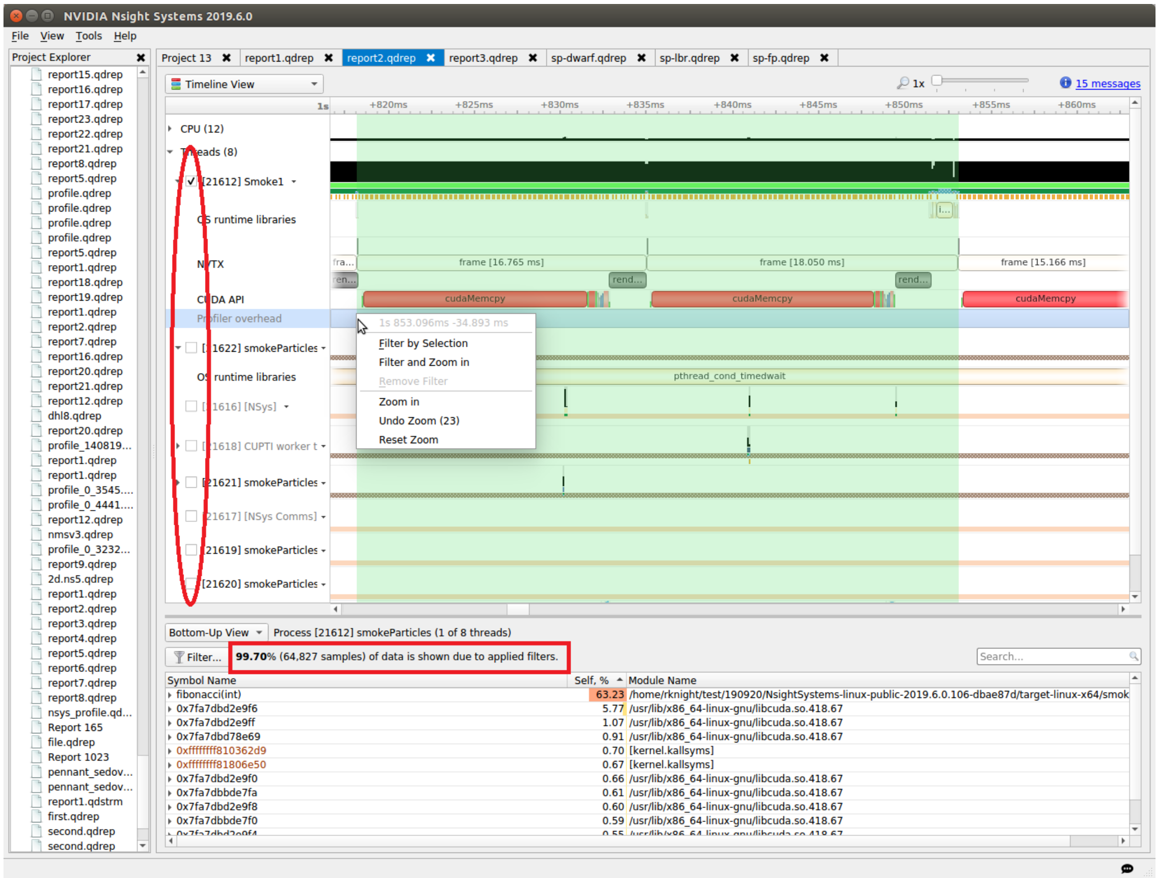
When a collection result is opened in the Nsight Systems GUI, there are multiple ways to view the CPU profiling data - especially the CPU IP / backtrace data.



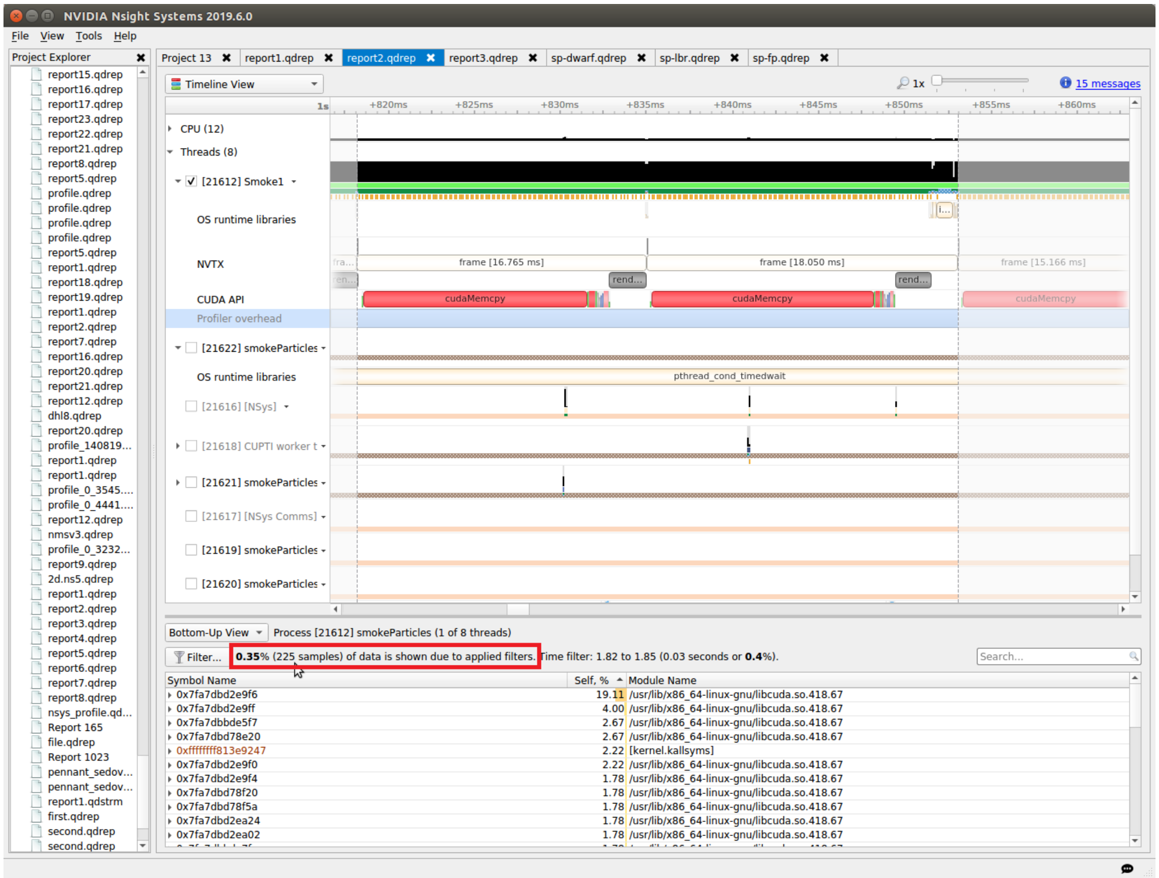
In the timeline, yellow-orange marks can be found under each thread's timeline that indicate the moment an IP / backtrace sample was collected on that thread (e.g. see the yellow-orange marks in the Specific Samples box above). Hovering the cursor over a mark will cause a tooltip to display the backtrace for that sample.

Below the Timeline is a drop-down list with multiple options including Events View, Top-Down View, Bottom-Up View, and Flat View. All four of these views can be used to view CPU IP / backtrace sampling data.

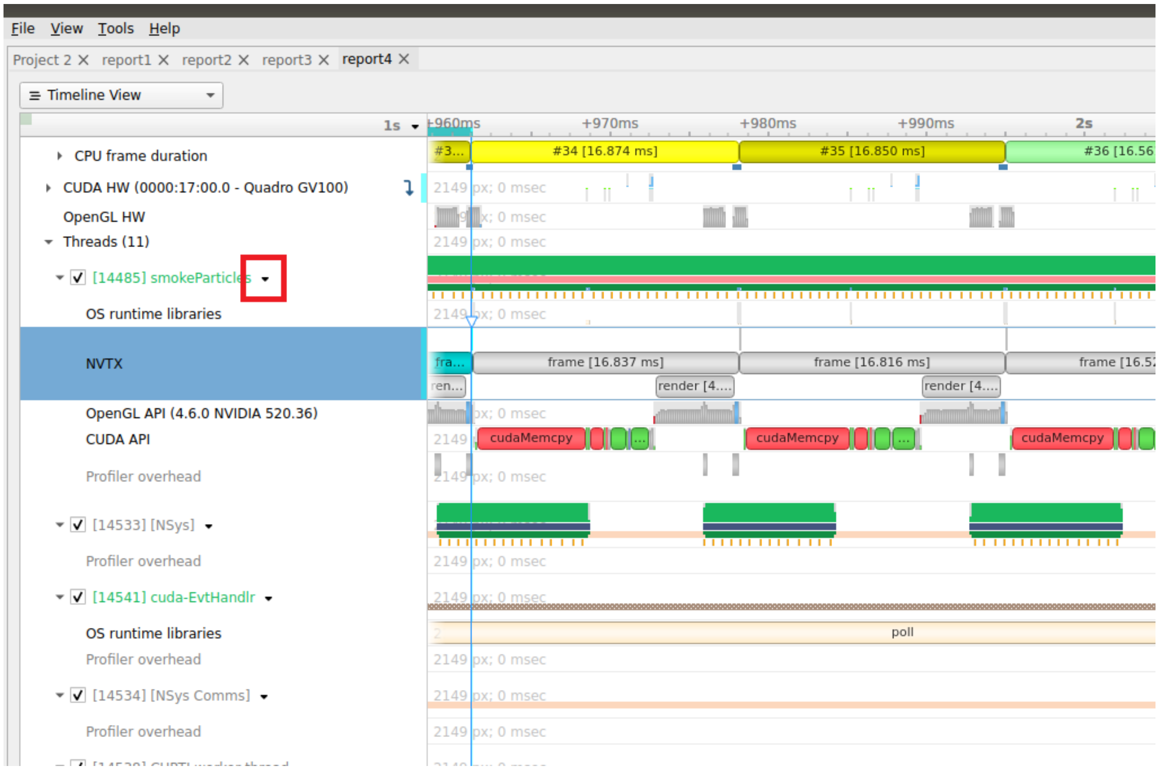
If the Bottom-Up View is selected, here is the sampling summary shown in the bottom half of the Timeline View screen. Notice that the summary includes the phrase “65,022 samples are used” indicating how many samples are summarized. By default, functions that were found in less less than 0.5% of the samples are not show. Use the **filter** button to modify that setting.



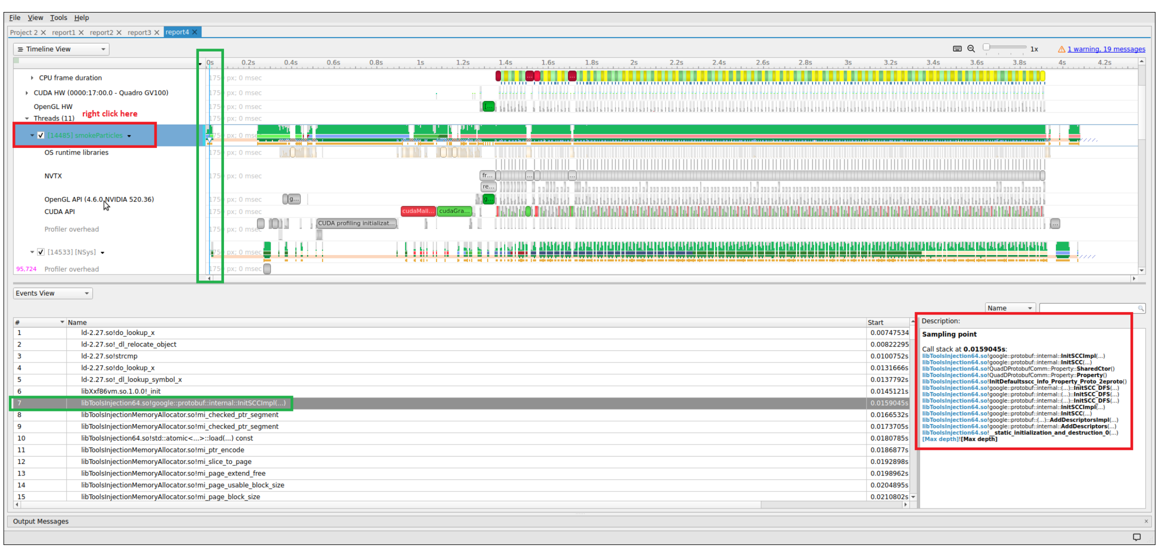
When sampling data is filtered, the Sampling Summary will summarize the selected samples. Samples can be filtered on an OS thread basis, on a time basis, or both. Above, deselecting a checkbox next to a thread removes its samples from the sampling summary. Dragging the cursor over the timeline and selecting "Filter and Zoom In" chooses the samples during the time selected, as seen below. The sample summary includes the phrase "0.35% (225 samples) of data is shown due to applied filters" indicating that only 225 samples are included in the summary results.



Deselecting threads one at a time by deselecting their checkbox can be tedious. Click on the down arrow next to a thread and choose Show Only This Thread to deselect all threads except that thread.

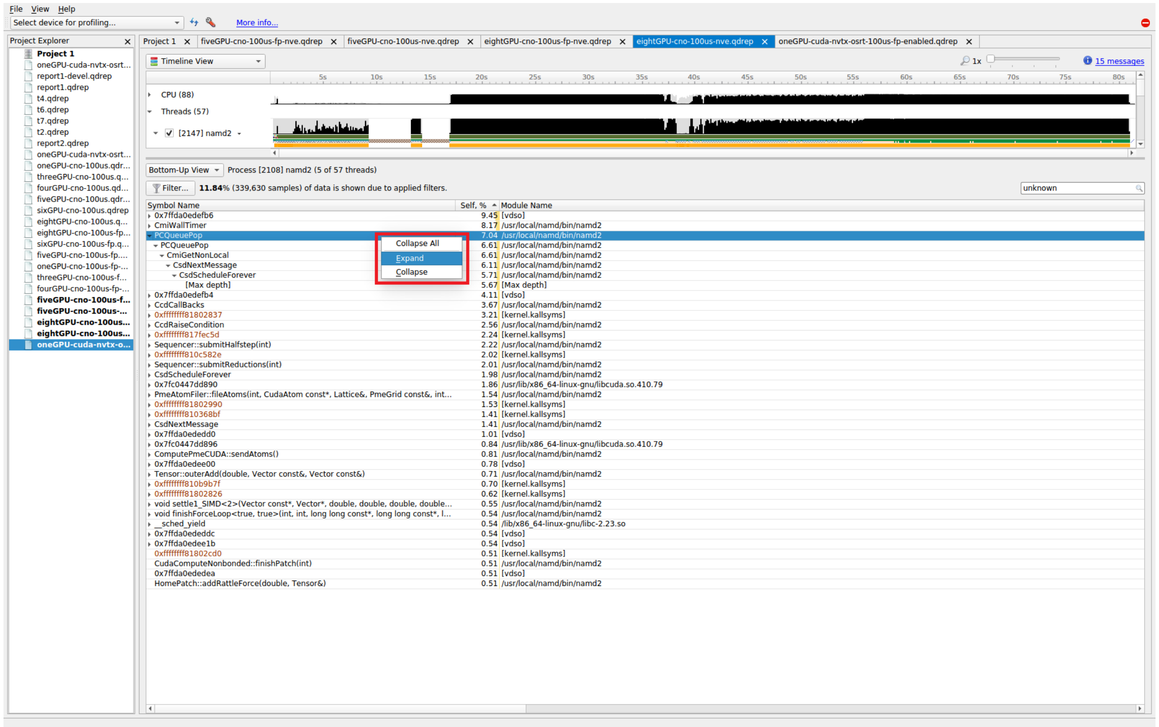


If Events View is selected in the Timeline View's drop-down list, right click on a specific thread and choose Show in Events View. The samples collected while that thread executed will be shown in the Events View. Double clicking on a specific sample in the Events view causes the timeline to show when that sample was collected - see the green boxes below. The backtrace for that sample is also shown in the Events View.



Backtraces

To understand the code path used to get to a specific function shown in the sampling summary, right click on a function and select Expand.



The above shows what happens when a function's backtraces are expanded. In this case, the PCQueuePop function was called from the CmiGetNonLocal function which was called by the CsdNextMessage function which was called by the CsdScheduleForever function. The [Max depth] string marks the end of the collected backtrace.

Note that, by default, backtraces with less than 0.5% of the total backtraces are hidden. This behavior can make the percentage results hard to understand. If all backtraces are shown (i.e. the filter is disabled), the results look very different and the numbers add up as expected. To disable the filter, click on the Filter… button and uncheck the Hide functions with CPU usage below X% checkbox.

When the filter is disabled, the backtraces are recalculated. Note that you may need to right click on the function and select Expand again to get all of the backtraces to be shown.

When backtraces are collected, the whole sample (IP and backtrace) is handled as a single sample. If two samples have the exact same IP and backtrace, they are summed in the final results. If two samples have the same IP but a different backtrace, they will be shown as having the same leaf (i.e. IP) but a different backtrace. As mentioned earlier, when backtraces end, they are marked with the [Max depth] string (unless the backtrace can be traced back to its origin - e.g. __libc_start_main) or the backtrace breaks because an IP cannot be resolved.

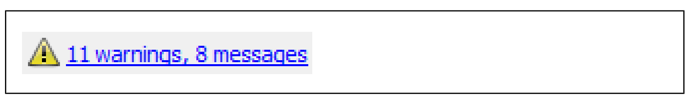
Above, the leaf function is PCQueuePop. In this case, there are 11 different backtraces that lead to PCQueuPop - all of them end with [Max depth]. For example, the dominant path is PCQueuPop<-CmiGetNonLocal<-CsdNextmessage<-CsdScheduleForever<-[Max depth]. This path accounts for 5.67% of all samples as shown in line 5 (red numbers). The second most dominant path is PCQueuePop<-CmiGetNonLocal<-[Max depth] which accounts for 0.44% of all samples as shown in line 24 (red numbers). The path PCQueuPop<-CmiGetNonLocal<-CsdNextmessage<-CsdScheduleForever<-Sequencer::integrate(int)<-[Max depth] accounts for 0.03% of the samples as shown in line 7 (red numbers). Adding up percentages shown in the [Max depth] lines (lines 5, 7, 9, 13, 15, 16, 17, 19, 21, 23, and 24) generates 7.04% which equals the percentage of samples associated with the PCQueuePop function shown in line 0 (red numbers).

23.7. Diagnostics Summary View

This view shows important messages. Some of them were generated during the profiling session, while some were added while processing and analyzing data in the report. Messages can be one of the following types:

- Informational messages
- Warnings
- Errors

To draw attention to important diagnostics messages, a summary line is displayed on the timeline view in the top right corner:



Information from this view can be selected and copied using the mouse cursor.

23.8. Symbol Resolution Logs View

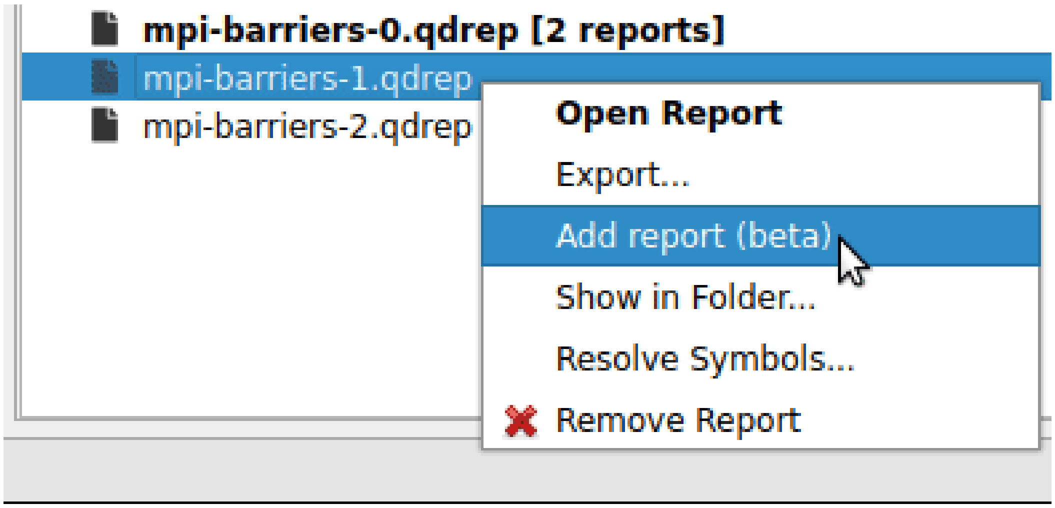
This view shows all messages related to the process of resolving symbols. It might be useful to debug issues when some of the symbol names in the symbols table of the timeline view are unresolved.

Chapter 24. ADDING REPORT TO THE TIMELINE

Starting with 2021.3, Nsight Systems can load multiple report files into a single timeline. This is a BETA feature and will be improved in the future releases. Please let us know about your experience on the forums or through **Help > Send Feedback...** in the main menu.

To load multiple report files into a single timeline, first start by opening a report as usual — using **File > Open...** from the main menu, or double clicking on a report in the Project Explorer window. Then additional report files can be loaded into the same timeline using one of the methods:

- **File > Add Report (beta)...** in the main menu, and select another report file that you want to open
- Right click on the report in the project explorer window, and click **Add Report (beta)**



24.1. Time Synchronization

When multiple reports are loaded into a single timeline, timestamps between them need to be adjusted, such that events that happened at the same time appear to be aligned.

Nsight Systems can automatically adjust timestamps based on **UTC time** recorded around the collection start time. This method is used by default when other more precise methods are not available. This time can be seen as **`UTC time at t=0`** in the *Analysis Summary* page of the report file. Refer to your OS documentation to learn how to sync the software clock using the Network Time Protocol (NTP). NTP-based time synchronization is not very precise, with the typical errors on the scale of one to tens of milliseconds.

Reports collected on the same physical machine can use synchronization based on **Timestamp Counter (TSC) values**. These are platform-specific counters, typically accessed in user space applications using the RDTSC instruction on x86_64 architecture, or by reading the CNTVCT register on Arm64. Their values converted to nanoseconds can be seen as **`TSC value at t=0`** in the *Analysis Summary* page of the report file. Reports synchronized using TSC values can be aligned with nanoseconds-level precision.

TSC-based time synchronization is activated automatically, when Nsight Systems detects that reports come from same target and that the same TSC value corresponds to very close UTC times. Targets are considered to be the same when either explicitly set environment variables **`NSYS_HW_ID`** are the same for both reports or when target hostnames are the same and **`NSYS_HW_ID`** is not set for either target. The difference between UTC and TSC time offsets must be below 1 second to choose TSC-based time synchronization.

To find out which synchronization method was used, navigate to the *Analysis Summary* tab of an added report and check the **`Report alignment source`** property of a target. Note, that the first report won't have this parameter.

Target

Target name	9a1630ecdd6a
Local time at t=0	2021-07-02T12:01:57.310Z
UTC time at t=0	2021-07-02T12:01:57.310Z
TSC value at t=0	1041856117291223
Report alignment source	TSC

Target

Target name	9e2247e584e1
Local time at t=0	2021-07-02T12:01:57.311Z
UTC time at t=0	2021-07-02T12:01:57.311Z
TSC value at t=0	1041856118165144
Report alignment source	UTC

When loading multiple reports into a single timeline, it is always advisable to first check that time synchronization looks correct, by zooming into synchronization or communication events that are expected to be aligned.

24.2. Timeline Hierarchy

When reports are added to the same timeline Nsight Systems will automatically line them up by timestamps as described above. If you want Nsight Systems to also recognize matching process or hardware information, you will need to set environment variables **`NSYS_SYSTEM_ID`** and **`NSYS_HW_ID`** as shown below at the time of report collection (such as when using "nsys profile ..." command).

When loading a pair of given report files into the same timeline, they will be merged in one of the following configurations:

- Different hardware — is used when reports are coming from different physical machines, and no hardware resources are shared in these reports. This mode is used when neither **`NSYS_HW_ID`** or **`NSYS_SYSTEM_ID`** is set and target hostnames are different or absent, and can be additionally signalled by specifying different **`NSYS_HW_ID`** values.
- Different systems, same hardware — is used when reports are collected on different virtual machines (VMs) or containers on the same physical machine. To activate this mode, specify the same value of **`NSYS_HW_ID`** when collecting the reports.
- Same system — is used when reports are collected within the same operating system (or container) environment. In this mode a process identifier (PID) 100 will refer to the same process in both reports. To manually activate this mode, specify the same value of **`NSYS_SYSTEM_ID`** when collecting the reports. This mode is automatically selected when target hostnames are the same and neither **`NSYS_HW_ID`** or **`NSYS_SYSTEM_ID`** is provided.

The following diagrams demonstrate typical cases:

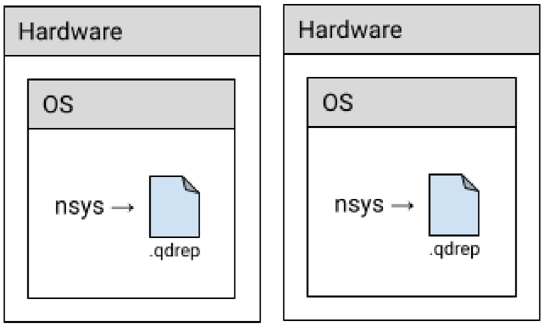


Fig 1. Different hardware (default mode)

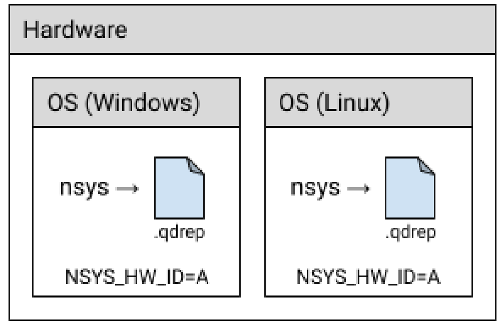


Fig 2. Same hardware, different systems (VMs)

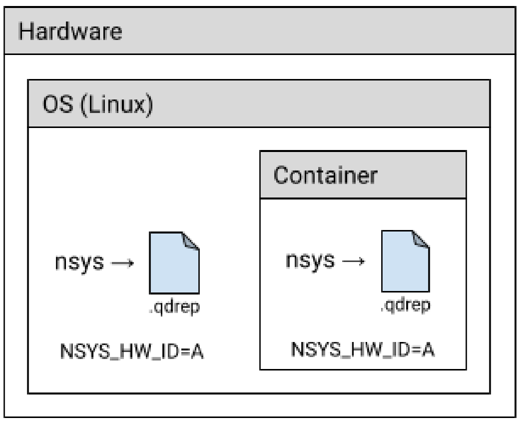


Fig 3. Same hardware, different systems (host and container)

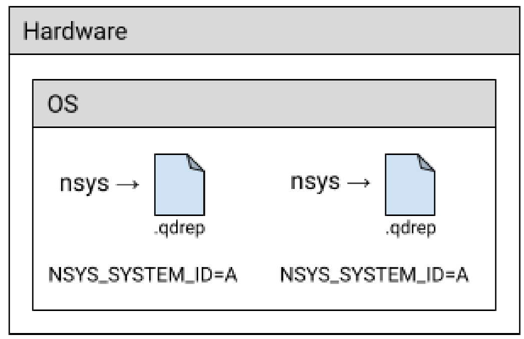


Fig 4. Same system

24.3. Example: MPI

A typical scenario is when a computing job is run using one of the MPI implementations. Each instance of the app can be profiled separately, resulting in multiple report files. For example:

```
# Run MPI job without the profiler:
mpirun <mpirun-options> ./myApp
# Run MPI job and profile each instance of the application:
mpirun <mpirun-options> nsys profile -o report-%p <nsys-options>./myApp
```

When each MPI rank runs on a different node, the command above works fine, since the default pairing mode (different hardware) will be used.

When all MPI ranks run the localhost only, use this command (value "A" was chosen arbitrarily, it can be any non-empty string):

NSYS_SYSTEM_ID=A mpirun <mpirun-options> nsys profile -o report-%p <nsys-options> ./myApp

For convenience, the MPI rank can be encoded into the report filename. For Open MPI, use the following command to create report files based on the global rank value:

```
mpirun <mpirun-options> nsys profile -o report-
%q{OMPI_COMM_WORLD_RANK} <nsys-options> ./myApp
```

MPICH-based implementations set the environment variable **`PMI_RANK`** and Slurm (**`srun`**) provides the global MPI rank in **`SLURM_PROCID`**.

24.4. Limitations

- Only report files collected with Nsight Systems version 2021.3 and newer are fully supported.
- Sequential reports collected in a single CLI profiling session cannot be loaded into a single timeline yet.

Chapter 25. USING NSIGHT SYSTEMS EXPERT SYSTEM

The Nsight Systems expert system is a feature aimed at automatic detection of performance optimization opportunities in an application's profile. It uses a set of predefined rules to determine if the application has known bad patterns.

Using Expert System from the CLI

usage:

```
nsys [global-options] analyze [options]
       [nsys-rep-or-sqlite-file]
```

If a .nsys-rep file is given as the input file and there is no .sqlite file with the same name in the same directory, it will be generated.

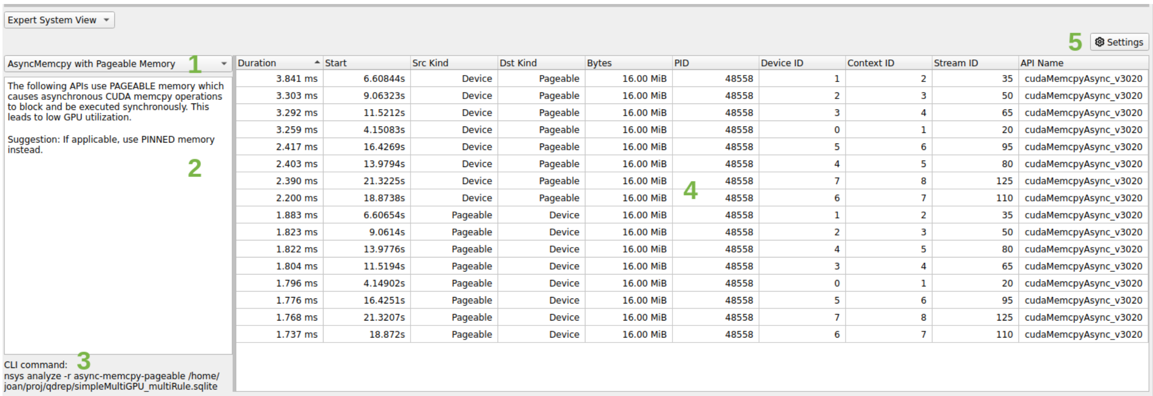
Note: The Expert System view in the GUI will give you the equivalent command line.

Using Expert System from the GUI

The Expert System View can be found in the same drop-down as the Events View. If there is no .sqlite file with the same name as the .nsys-rep file in the same directory, it will be generated.

The Expert System View has the following components:

1. Drop-down to select the rule to be run
2. Rule description and advice summary
3. CLI command that will give the same result
4. Table containing results of running the rule
5. Settings button that allows users to specify the rule's arguments



Duration	Start	Src Kind	Dst Kind	Bytes	PID	Device ID	Context ID	Stream ID	API Name
3.841 ms	6.60844s	Device	Pageable	16.00 MiB	48558	1	2	35	cudaMemcpyAsync_v3020
3.303 ms	9.06323s	Device	Pageable	16.00 MiB	48558	2	3	50	cudaMemcpyAsync_v3020
3.292 ms	11.5212s	Device	Pageable	16.00 MiB	48558	3	4	65	cudaMemcpyAsync_v3020
3.259 ms	4.15083s	Device	Pageable	16.00 MiB	48558	0	1	20	cudaMemcpyAsync_v3020
2.417 ms	16.4269s	Device	Pageable	16.00 MiB	48558	5	6	95	cudaMemcpyAsync_v3020
2.403 ms	13.9794s	Device	Pageable	16.00 MiB	48558	4	5	80	cudaMemcpyAsync_v3020
2.390 ms	21.3225s	Device	Pageable	16.00 MiB	48558	7	8	125	cudaMemcpyAsync_v3020
2.200 ms	18.8738s	Device	Pageable	16.00 MiB	48558	6	7	110	cudaMemcpyAsync_v3020
1.883 ms	6.60654s	Pageable	Device	16.00 MiB	48558	1	2	35	cudaMemcpyAsync_v3020
1.823 ms	9.0614s	Pageable	Device	16.00 MiB	48558	2	3	50	cudaMemcpyAsync_v3020
1.822 ms	13.9776s	Pageable	Device	16.00 MiB	48558	4	5	80	cudaMemcpyAsync_v3020
1.804 ms	11.5194s	Pageable	Device	16.00 MiB	48558	3	4	65	cudaMemcpyAsync_v3020
1.796 ms	4.14902s	Pageable	Device	16.00 MiB	48558	0	1	20	cudaMemcpyAsync_v3020
1.776 ms	16.4251s	Pageable	Device	16.00 MiB	48558	5	6	95	cudaMemcpyAsync_v3020
1.768 ms	21.3207s	Pageable	Device	16.00 MiB	48558	7	8	125	cudaMemcpyAsync_v3020
1.737 ms	18.872s	Pageable	Device	16.00 MiB	48558	6	7	110	cudaMemcpyAsync_v3020

A context menu is available to correlate the table entry with the timeline. The options are the same as the Events View:

- Zoom to Selected on Timeline (ctrl+double-click)

The highlighting is not supported for rules that do not return an event but rather an arbitrary time range (e.g. GPU utilization rules).

The CLI and GUI share the same rule scripts and messages. There might be some formatting differences between the output table in GUI and CLI.

Expert System Rules

Rules are scripts that run on the SQLite DB output from Nsight Systems to find common improvable usage patterns.

Each rule has an advice summary with explanation of the problem found and suggestions to address it. Only the top 50 results are displayed by default.

There are currently six rules in the expert system. They are described below. Additional rules will be made available in a future version of Nsight Systems.

CUDA Synchronous Operation Rules

Asynchronous memcpy with pageable memory

This rule identifies asynchronous memory transfers that end up becoming synchronous if the memory is pageable. This rule is not applicable for Nsight Systems Embedded Platforms Edition

Suggestion: If applicable, use pinned memory instead

Synchronous Memcpy

This rule identifies synchronous memory transfers that block the host.

Suggestion: Use cudaMemcpy*Async APIs instead.

Synchronous Memset

This rule identifies synchronous memset operations that block the host.

Suggestion: Use cudaMemset*Async APIs instead.

Synchronization APIs

This rule identifies synchronization APIs that block the host until all issued CUDA calls are complete.

Suggestions: Avoid excessive use of synchronization. Use asynchronous CUDA event calls, such as cudaStreamWaitEvent and cudaEventSynchronize, to prevent host synchronization.

GPU Low Utilization Rules

Nsight Systems determines GPU utilization based on API trace data in the collection. Current rules consider CUDA, Vulkan, DX12, and OpenGL API use of the GPU.

GPU Starvation

This rule identifies time ranges where a GPU is idle for longer than 500ms. The threshold is adjustable.

Suggestions: Use CPU sampling data, OS Runtime blocked state backtraces, and/or OS Runtime APIs related to thread synchronization to understand if a sluggish or blocked CPU is causing the gaps. Add NVTX annotations to CPU code to understand the reason behind the gaps.

Notes:

- For each process, each GPU is examined, and gaps are found within the time range that starts with the beginning of the first GPU operation on that device and ends with the end of the last GPU operation on that device.
- GPU gaps that cannot be addressed by the user are excluded. This includes:
  - Profiling overhead in the middle of a GPU gap.
  - The initial gap in the report that is seen before the first GPU operation.
  - The final gap that is seen after the last GPU operation.

GPU Low Utilization

This rule identifies time regions with low utilization.

Suggestions: Use CPU sampling data, OS Runtime blocked state backtraces, and/or OS Runtime APIs related to thread synchronization to understand if a sluggish or blocked CPU is causing the gaps. Add NVTX annotations to CPU code to understand the reason behind the gaps.

Notes:

- For each process, each GPU is examined, and gaps are found within the time range that starts with the beginning of the first GPU operation on that device and ends with the end of the last GPU operation on that device. This time range is then divided into equal chunks, and the GPU utilization is calculated for each chunk. The utilization includes all GPU operations as well as profiling overheads that the user cannot address.
- The utilization refers to the "time" utilization and not the "resource" utilization. This rule attempts to find time gaps when the GPU is or isn't being used, but does not take into account how many GPU resources are being used. Therefore, a single running memcpy is considered the same amount of "utilization" as a huge kernel that takes over all the cores. If multiple operations run concurrently in the same chunk, their utilization will be added up and may exceed 100%.
- Chunks with an in-use percentage less than the threshold value are displayed. If consecutive chunks have a low in-use percentage, the individual chunks are coalesced into a single display record, keeping the weighted average of percentages. This is why returned chunks may have different durations.

Chapter 26. IMPORT NVTXT

ImportNvtxt is an utility which allows conversion of a NVTXT file to a Nsight Systems report file (*.nsys-rep) or to merge it with an existing report file.

Note: NvtxtImport supports custom **TimeBase** values. Only these values are supported:

- **Manual** — timestamps are set using absolute values.
- **Relative** — timestamps are set using relative values with regards to report file which is being merged with nvtxt file.
- **ClockMonotonicRaw** — timestamps values in nvtxt file are considered to be gathered on the same target as the report file which is to be merged with nvtxt using **`clock_gettime(CLOCK_MONOTONIC_RAW, ...)`** call.
- **CNTVCT** — timestamps values in nvtxt file are considered to be gathered on the same target as the report file which is to be merged with nvtxt using CNTVCT values.

You can get usage info via help message:

Print help message:

```
-h [ --help ]
```

Show information about report file:

```
--cmd info -i [--input] arg
```

Create report file from existing nvtxt file:

```
--cmd create -n [--nvtxt] arg -o [--output] arg [-m [--mode] mode_name
 mode_args] [--target <Hw:Vm>] [--update_report_time]
```

Merge nvtxt file to existing report file:

```
--cmd merge -i [--input] arg -n [--nvtxt] arg -o [--output] arg [-m [--mode]
 mode_name mode_args] [--target <Hw:Vm>] [--update_report_time]
```

Modes description:

- lerp - Insert with linear interpolation

  ```
  --mode lerp --ns_a arg --ns_b arg [--nvtxt_a arg --nvtxt_b arg]
  ```
- lin - insert with linear equation

  ```
  --mode lin  --ns_a arg --freq arg [--nvtxt_a arg]
  ```

Modes' parameters:

- ns_a - a nanoseconds value
- ns_b - a nanoseconds value (greater than ns_a)
- nvtxt_a - an nvtxt file's time unit value corresponding to ns_a nanoseconds
- nvtxt_b - an nvtxt file's time unit value corresponding to ns_b nanoseconds
- freq - the nvtxt file's timer frequency
- --target <Hw:Vm> - specify target id, e.g. --target 0:1
- --update_report_time - prolong report's profiling session time while merging if needed. Without this option all events outside the profiling session time window will be skipped during merging.

Commands

Info

To find out report's start and end time use **info** command.

Usage:

```
ImportNvtxt --cmd info -i [--input] arg
```

Example:

```
ImportNvtxt info Report.nsys-rep
Analysis start (ns) 83501026500000
Analysis end (ns) 83506375000000
```

Create

You can create a report file using existing NVTXT with **create** command.

Usage:

```
ImportNvtxt --cmd create -n [--nvtxt] arg -o [--output] arg [-m [--mode]
 mode_name mode_args]
```

Available modes are:

- **lerp** — insert with linear interpolation.
- **lin** — insert with linear equation.

Usage for **lerp** mode is:

```
--mode lerp --ns_a arg --ns_b arg [--nvtxt_a arg --nvtxt_b arg]
```

with:

- **`ns_a`** — a nanoseconds value.
- **`ns_b`** — a nanoseconds value (greater than **`ns_a`**).
- **`nvtxt_a`** — an nvtxt file's time unit value corresponding to **`ns_a`** nanoseconds.
- **`nvtxt_b`** — an nvtxt file's time unit value corresponding to **`ns_b`** nanoseconds.

If **`nvtxt_a`** and **`nvtxt_b`** are not specified, they are respectively set to nvtxt file's minimum and maximum time value.

Usage for **lin** mode is:

```
--mode lin --ns_a arg --freq arg [--nvtxt_a arg]
```

with:

- **ns_a** — a nanoseconds value.
- **freq** — the nvtxt file's timer frequency.
- **nvtxt_a** — an nvtxt file's time unit value corresponding to **ns_a** nanoseconds.

If **nvtxt_a** is not specified, it is set to nvtxt file's minimum time value.

Examples:

```
ImportNvtxt --cmd create -n Sample.nvtxt -o Report.nsys-rep
```

The output will be a new generated report file which can be opened and viewed by Nsight Systems.

Merge

To merge NVTXT file with an existing report file use **merge** command.

Usage:

```
ImportNvtxt --cmd merge -i [--input] arg -n [--nvtxt] arg -o [--output] arg [-m
 [--mode] mode_name mode_args]
```

Available modes are:

- **lerp** — insert with linear interpolation.
- **lin** — insert with linear equation.

Usage for **lerp** mode is:

```
--mode lerp --ns_a arg --ns_b arg [--nvtxt_a arg --nvtxt_b arg]
```

with:

- **ns_a** — a nanoseconds value.
- **ns_b** — a nanoseconds value (greater than **ns_a**).
- **nvtxt_a** — an nvtxt file's time unit value corresponding to **ns_a** nanoseconds.
- **nvtxt_b** — an nvtxt file's time unit value corresponding to **ns_b** nanoseconds.

If **nvtxt_a** and **nvtxt_b** are not specified, they are respectively set to nvtxt file's minimum and maximum time value.

Usage for **lin** mode is:

```
--mode lin  --ns_a arg --freq arg [--nvtxt_a arg]
```

with:

- **ns_a** — a nanoseconds value.
- **freq** — the nvtxt file's timer frequency.
- **nvtxt_a** — an nvtxt file's time unit value corresponding to **ns_a** nanoseconds.

If **nvtxt_a** is not specified, it is set to nvtxt file's minimum time value.

Time values in **<filename.nvtxt>** are assumed to be nanoseconds if no mode specified.

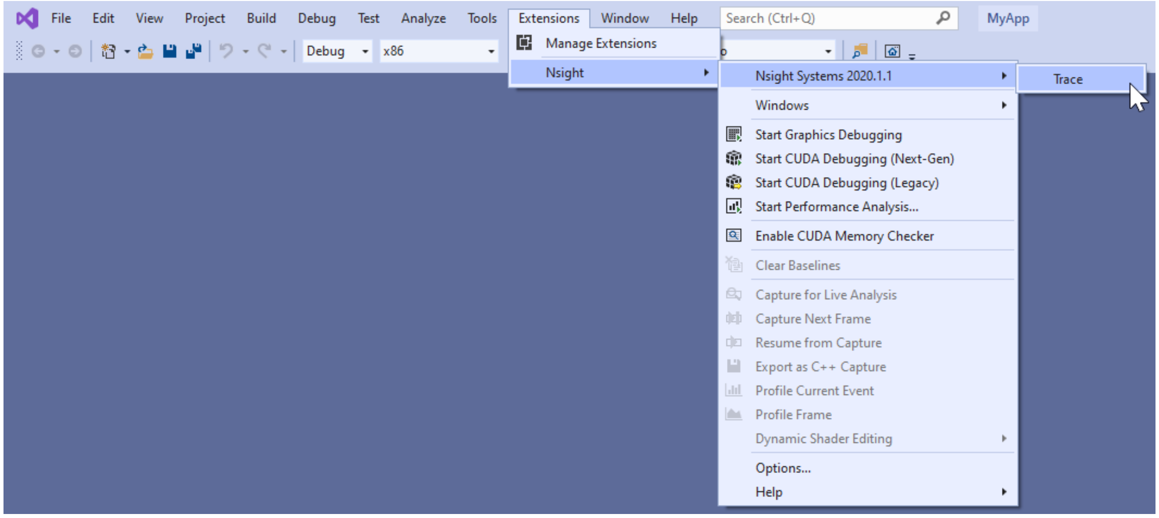
Example

```
ImportNvtxt --cmd merge -i Report.nsys-rep -n Sample.nvtxt -o NewReport.nsys-rep
```

Chapter 27. VISUAL STUDIO INTEGRATION

NVIDIA Nsight Integration is a Visual Studio extension that allows you to access the power of Nsight Systems from within Visual Studio.

When Nsight Systems is installed along with NVIDIA Nsight Integration, Nsight Systems activities will appear under the NVIDIA Nsight menu in the Visual Studio menu bar. These activities launch Nsight Systems with the current project settings and executable.



Selecting the "Trace" command will launch Nsight Systems, create a new Nsight Systems project and apply settings from the current Visual Studio project:

- Target application path
- Command line parameters
- Working folder

If the "Trace" command has already been used with this Visual Studio project then Nsight Systems will load the respective Nsight Systems project and any previously captured trace sessions will be available for review using the Nsight Systems project explorer tree.

For more information about using Nsight Systems from within Visual Studio, please visit

- NVIDIA Nsight Integration Overview
- NVIDIA Nsight Integration User Guide

Chapter 28. TROUBLESHOOTING

28.1. General Troubleshooting

Profiling

If the profiler behaves unexpectedly during the profiling session, or the profiling session fails to start, try the following steps:

- Close the host application.
- Restart the target device.
- Start the host application and connect to the target device.

Nsight Systems uses a settings file (**`NVIDIA Nsight Systems.ini`**) on the host to store information about loaded projects, report files, window layout configuration, etc. Location of the settings file is described in the **Help** # **About** dialog. Deleting the settings file will restore Nsight Systems to a fresh state, but all projects and reports will disappear from the Project Explorer.

Environment Variables

By default, Nsight Systems writes temporary files to **`/tmp`** directory. If you are using a system that does not allow writing to **`/tmp`** or where the **`/tmp`** directory has limited storage you can use the TMPDIR environment variable to set a different location. An example:

```
TMPDIR=/testdata ./bin/nsys profile -t cuda matrixMul
```

Environment variable control support for Windows target trace is not available, but there is a quick workaround:

- Create a batch file that sets the env vars and launches your application.
- Set Nsight Systems to launch the batch file as its target, i.e. set the project settings target path to the path of batch file.
- Start the trace. Nsight Systems will launch the batch file in a new cmd instance and trace any child process it launches. In fact, it will trace the whole process tree whose root is the cmd running your batch file.

WebGL Testing

Nsight Systems cannot profile using the default Chrome launch command. To profile WebGL please follow the following command structure:

```
"C:\Program Files (x86)\Google\Chrome\Application\chrome.exe"
       --inprocess-gpu --no-sandbox --disable-gpu-watchdog --use-angle=gl
       https://webglsamples.org/aquarium/aquarium.html
```

Common Issues with QNX Targets

- Make sure that **`tracelogger`** utility is available and can be run on the target.
- Make sure that **`/tmp`** directory is accessible and supports sub-directories.
- When switching between Nsight Systems versions, processes related to the previous version, including profiled applications forked by the daemon, must be killed before the new version is used. If you experience issues after switching between Nsight Systems versions, try rebooting the target.

28.2. CLI Troubleshooting

If you have collected a report file using the CLI and the report will not open in the GUI, check to see that your GUI version is the same or greater than the CLI version you used. If it is not, download a new version of the Nsight Systems GUI and you will be able to load and visualize your report.

This situation occurs most frequently when you update Nsight Systems using a CLI only package, such as the package available from the NVIDIA HPC SDK.

28.3. Launch Processes in Stopped State

In many cases, it is important to profile an application from the very beginning of its execution. When launching processes, Nsight Systems takes care of it by making sure that the profiling session is fully initialized before making the **`exec()`** system call on Linux.

If the process launch capabilities of Nsight Systems are not sufficient, the application should be launched manually, and the profiler should be configured to attach to the already launched process. One approach would be to call **`sleep()`** somewhere early in the application code, which would provide time for the user to attach to the process in Nsight Systems Embedded Platforms Edition, but there are two other more convenient mechanisms that can be used on Linux, without the need to recompile the application. (Note that the rest of this section is only applicable to Linux-based target devices.)

Both mechanisms ensure that between the time the process is created (and therefore its PID is known) and the time any of the application's code is called, the process is stopped and waits for a signal to be delivered before continuing.

LD_PRELOAD

The first mechanism uses **LD_PRELOAD** environment variable. It only works with dynamically linked binaries, since static binaries do not invoke the runtime linker, and therefore are not affected by the **LD_PRELOAD** environment variable.

- For ARMv7 binaries, preload
  ```
  /opt/nvidia/nsight_systems/libLauncher32.so
  ```
- Otherwise if running from host, preload
  ```
  /opt/nvidia/nsight_systems/libLauncher64.so
  ```
- Otherwise if running from CLI, preload
  ```
  [installation_directory]/libLauncher64.so
  ```

The most common way to do that is to specify the environment variable as part of the process launch command, for example:

```
$ LD_PRELOAD=/opt/nvidia/nsight_systems/libLauncher64.so ./my-aarch64-binary --
arguments
```

When loaded, this library will send itself a **SIGSTOP** signal, which is equivalent to typing **Ctrl+Z** in the terminal. The process is now a background job, and you can use standard commands like jobs, **fg** and **bg** to control them. Use **jobs -l** to see the PID of the launched process.

When attaching to a stopped process, Nsight Systems will send **SIGCONT** signal, which is equivalent to using the **bg** command.

Launcher

The second mechanism can be used with any binary. Use **[installation_directory]/launcher** to launch your application, for example:

```
$ /opt/nvidia/nsight_systems/launcher ./my-binary --arguments
```

The process will be launched, daemonized, and wait for **SIGUSR1** signal. After attaching to the process with Nsight Systems, the user needs to manually resume execution of the process from command line:

```
$ pkill -USR1 launcher
```

Note: Note that **pkill** will send the signal to any process with the matching name. If that

	is not desirable, use **`kill`** to send it to a specific process. The standard output and error streams are redirected to **`/tmp/stdout_<PID>.t`** and **`/tmp/stderr_<PID>.t`**

The launcher mechanism is more complex and less automated than the LD_PRELOAD option, but gives more control to the user.

28.4. GUI Troubleshooting

If opening the Nsight Systems Linux GUI fails with one of the following errors, you may be missing some required libraries:

```
This application failed to start because it could not find or load the Qt
 platform plugin "xcb" in "". Available platform plugins are: xcb. Reinstalling
 the application may fix this problem.
```

or

```
error while loading shared libraries: [library_name]: cannot open shared object
 file: No such file or directory
```

Ubuntu 18.04/20.04/22.04 and CentOS 7/8/9 with root privileges

- Launch the following command, which will install all the required libraries in system directories:

  ```
  [installation_path]/host-linux-[arch]/Scripts/DependenciesInstaller/install-dependencies.sh
  ```

- Launch the Linux GUI as usual.

Ubuntu 18.04/20.04/22.04 and CentOS 7/8/9 without root privileges

- Choose the directory where dependencies will be installed (**`dependencies_path`**). This directory should be writeable for the current user.
- Launch the following command (if it has already been run, move to the next step), which will install all the required libraries in **`[dependencies_path]`**:

```
[installation_path]/host-linux-[arch]/Scripts/DependenciesInstaller/install-
dependencies-without-root.sh [dependencies_path]
```

- Further, use the following command to launch the Linux GUI:

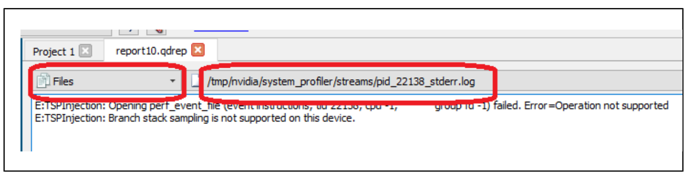
```
source [installation_path]/host-linux-[arch]/Scripts/DependenciesInstaller/
setup-dependencies-environment.sh [dependencies_path] &&
 [installation_path]/host-linux-x64/nsys-ui
```

Other platforms, or if the previous steps did not help

Launch Nsight Systems using the following command line to determine which libraries are missing and install them.

```
$ QT_DEBUG_PLUGINS=1 ./nsys-ui
```

If the workload does not run when launched via Nsight Systems or the timeline is empty, check the stderr.log and stdout.log (click on drop-down menu showing **Timeline View** and click on **Files**) to see the errors encountered by the app.



28.5. Symbol Resolution

If stack trace information is missing symbols and you have a symbol file, you can manually re-resolve using the ResolveSymbols utility. This can be done by right-clicking the report file in the Project Explorer window and selecting "Resolve Symbols...".

Alternatively, you can find the utility as a separate executable in the **`[installation_path]\Host`** directory. This utility works with ELF format files, with Windows PDB directories and symbol servers, or with files where each line is in the format **`<start><length><name>`**.

Short	Long	Argument	Description
-h	--help		Help message providing information about available options.

Short	Long	Argument	Description
-l	--process-list		Print global process IDs list
-s	--sym-file	filename	Path to symbol file
-b	--base-addr	address	If set then <start> in symbol file is treated as relative address starting from this base address
-p	--global-pid	pid	Which process in the report should be resolved. May be omitted if there is only one process in the report.
-f	--force		This option forces use of a given symbol file.
-i	--report	filename	Path to the report with unresolved symbols.
-o	--output	filename	Path and name of the output file. If it is omitted then "resolved" suffix is added to the original filename.
-d	--directories	directory paths	List of symbol folder paths, separated by semi-colon characters. Available only on Windows.
-v	--servers	server URLs	List of symbol servers that uses the same format as **_NT_SYMBOL_PATH** environment variable, i.e. **srv*<LocalStore>*<SymbolServe** Available only on Windows.

Short	Long	Argument	Description
-n	--ignore-nt-sym-path		Ignore the symbol locations stored in the **`_NT_SYMBOL_PATH`** environment variable. Available only on Windows.

Broken Backtraces on Tegra

In Nsight Systems Embedded Platforms Edition, in the symbols table there is a special entry called **Broken backtraces**. This entry is used to denote the point in the call chain where the unwinding algorithms used by Nsight Systems could not determine what is the next (caller) function.

Broken backtraces happen because there is no information related to the current function that the unwinding algorithms can use. In the Top-Down view, these functions are immediate children of the Broken backtraces row.

One can eliminate broken backtraces by modifying the build system to provide at least one kind of unwind information. The types of unwind information, used by the algorithms in Nsight Systems, include the following:

For ARMv7 binaries:

- DWARF information in ELF sections: **`.debug_frame`**, **`.zdebug_frame`**, **`.eh_frame`**, **`.eh_frame_hdr`**. This information is the most precise. **`.zdebug_frame`** is a compressed version of **`.debug_frame`**, so at most one of them is typically present. **`.eh_frame_hdr`** is a companion section for **`.eh_frame`** and might be absent.

  Compiler flag: **`-g`**.
- Exception handling information in EHABI format provided in **`.ARM.exidx`** and **`.ARM.extab`** ELF sections. **`.ARM.extab`** might be absent if all information is compact enough to be encoded into **`.ARM.exidx`**.

  Compiler flag: **`-funwind-tables`**.
- Frame pointers (built into the **`.text`** section).

  Compiler flag: **`-fno-omit-frame-pointer`**.

For Aarch64 binaries:

- DWARF information in ELF sections: **`.debug_frame`**, **`.zdebug_frame`**, **`.eh_frame`**, **`.eh_frame_hdr`**. See additional comments above.

  Compiler flag: **`-g`**.
- Frame pointers (built into the **`.text`** section).

  Compiler flag: **`-fno-omit-frame-pointer`**.

The following ELF sections should be considered empty if they have size of 4 bytes: **.debug_frame**, **.eh_frame**, **.ARM.exidx**. In this case, these sections only contain termination records and no useful information.

For GCC, use the following compiler invocation to see which compiler flags are enabled in your toolchain by default (for example, to check if **-funwind-tables** is enabled by default):

```
$ gcc -Q --help=common
```

For GCC and Clang, add **-###** to the compiler invocation command to see which compiler flags are actually being used.

Since EHABI and DWARF information is compiled on per-unit basis (every **.cpp** or **.c** file, as well as every static library, can be built with or without this information), presence of the ELF sections does not guarantee that every function has necessary unwind information.

Frame pointers are required by the Aarch64 Procedure Call Standard. Adding frame pointers slows down execution time, but in most cases the difference is negligible.

Debug Versions of ELF Files

Often, after a binary is built, especially if it is built with debug information (**-g** compiler flag), it gets stripped before deploying or installing. In this case, ELF sections that contain useful information, such as non-export function names or unwind information, can get stripped as well.

One solution is to deploy or install the original unstripped library instead of the stripped one, but in many cases this would be inconvenient. Nsight Systems can use missing information from alternative locations.

For target devices with Ubuntu, see Debug Symbol Packages. These packages typically install debug ELF files with **/usr/lib/debug** prefix. Nsight Systems can find debug libraries there, and if it matches the original library (e.g., the built-in **BuildID** is the same), it will be picked up and used to provide symbol names and unwind information.

Many packages have debug companions in the same repository and can be directly installed with APT (**apt-get**). Look for packages with the **-dbg** suffix. For other packages, refer to the Debug Symbol Packages wiki page on how to add the debs package repository. After setting up the repository and running apt-get update, look for packages with **-dbgsym** suffix.

To verify that a debug version of a library has been picked up and downloaded from the target device, look in the **Module Summary** section of **Analysis Summary**:

Module summary

Module name	Address	CPU time
[kernel.kallsyms]	0xffffffc000080000-0xffffffc001471010	53.46%
/lib/aarch64-linux-gnu/**libc-2.23.so** /usr/lib/debug/lib/aarch64-linux-gnu/**libc-2.23.so**	0x7f7ebad000-0x7f7ecda000	26.04%

28.6. Logging

To enable logging on the host, refer to this config file:

```
host-linux-x64/nvlog.config.template
```

When reporting any bugs please include the build version number as described in the **Help # About** dialog. If possible, attach log files and report (**.nsys-rep**) files, as they already contain necessary version information.

Verbose Remote Logging on Linux Targets

Verbose logging is available when connecting to a Linux-based device from the GUI on the host. This extra debug information is not available when launching via the command line. Nsight Systems installs its executable and library files into the following directory:

```
/opt/nvidia/nsight_systems/
```

To enable verbose logging on the target device, when launched from the host, follow these steps:

1. Close the host application.
2. Restart the target device.
3. Place **nvlog.config** from host directory to the **/opt/nvidia/nsight_systems** directory on target.
4. From SSH console, launch the following command:

   ```
   sudo /opt/nvidia/nsight_systems/nsys --daemon --debug
   ```
5. Start the host application and connect to the target device.

Logs on the target devices are collected into this file (if enabled):

```
nsys.log
```

in the directory where **nsys** command was launched.

Please note that in some cases, debug logging can significantly slow down the profiler.

Verbose CLI Logging on Linux Targets

To enable verbose logging of the Nsight Systems CLI and the target application's injection behavior:

1. In the target-linux-x64 directory, rename the nvlog.config.template file to nvlog.config.
2. Inside that file, change the line

   ```
   $ }}{{{}nsys-ui.log
   ```

   to

   ```
   $ }}{{{}nsys-agent.log
   ```
3. Run a collection and the **target-linux.x64** directory should include a file named **nsys-agent.log**.

Please note that in some cases, debug logging can significantly slow down the profiler.

Verbose Logging on Windows Targets

Verbose logging is available when connecting to a Windows-based device from the GUI on the host. Nsight Systems installs its executable and library files into the following directory by default:

```
C:\Program Files\NVIDIA Corporation\Nsight Systems 2022.3
```

To enable verbose logging on the target device, when launched from the host, follow these steps:

1. Close the host application.
2. Terminate the **`nsys`** process.
3. Place **`nvlog.config`** from host directory next to Nsight Systems Windows agent on the target device
    - Local Windows target:

      ```
      C:\Program Files\NVIDIA Corporation\Nsight Systems 2022.3\target-windows-x64
      ```
    - Remote Windows target:

      ```
      C:\Users\<user name>\AppData\Local\Temp\nvidia\nsight_systems
      ```
4. Start the host application and connect to the target device.

Logs on the target devices are collected into this file (if enabled):

```
nsight-sys.log
```

in the same directory as Nsight Systems Windows agent.

Please note that in some cases debug logging can significantly slow down the profiler.

Chapter 29. OTHER RESOURCES

Looking for information to help you use Nsight Systems the most effectively? Here are some more resources you might want to review:

Training Seminars

NVIDIA Deep Learning Institute Training - Self-Paced Online Course Optimizing CUDA Machine Learning Codes With Nsight Profiling Tools

2018 NCSA Blue Waters Webinar - Video Only Introduction to NVIDIA Nsight Systems

Blog Posts

NVIDIA developer blogs, these are longer form, technical pieces written by tool and domain experts.

- 2021 - Optimizing DX12 Resource Uploads to the GPU Using CPU-Visible VRAM
- 2019 - Migrating to NVIDIA Nsight Tools from NVVP and nvprof
- 2019 - Transitioning to Nsight Systems from NVIDIA Visual Profiler / nvprof
- 2019 - NVIDIA Nsight Systems Add Vulkan Support
- 2019 - TensorFlow Performance Logging Plugin nvtx-plugins-tf Goes Public
- 2020 - NVIDIA Nsight Systems in Containers and the Cloud
- 2020 - Understanding the Visualization of Overhead and Latency in Nsight Systems
- 2021 - Optimizing DX12 Resource Uploads to the GPU Using CPU-Visible VRAM

Feature Videos

Short videos, only a minute or two, to introduce new features.

- OpenMP Trace Feature Spotlight
- Command Line Sessions Video Spotlight
- Direct3D11 Feature Spotlight

- Vulkan Trace
- Statistics Driven Profiling
- Analyzing NCCL Usage with NVDIA Nsight Systems

Conference Presentations

- GTC 2022 - Killing Cloud Monsters Has Never Been Smoother
- GTC 2022 - Optimizing Communication with Nsight Systems Network Profiling
- GTC 2021 - Tuning GPU Network and Memory Usage in Apache Spark
- GTC 2020 - Rebalancing the Load: Profile-Guided Optimization of the NAMD Molecular Dynamics Program for Modern GPUs using Nsight Systems
- GTC 2020 - Scaling the Transformer Model Implementation in PyTorch Across Multiple Nodes
- GTC 2019 - Using Nsight Tools to Optimize the NAMD Molecular Dynamics Simulation Program
- GTC 2019 - Optimizing Facebook AI Workloads for NVIDIA GPUs
- GTC 2018 - Optimizing HPC Simulation and Visualization Codes Using NVIDIA Nsight Systems
- GTC 2018 - Israel - Boost DNN Training Performance using NVIDIA Tools
- Siggraph 2018 - Taming the Beast; Using NVIDIA Tools to Unlock Hidden GPU Performance

For More Support

To file a bug report or to ask a question on the Nsight Systems forums, you will need to register with the NVIDIA Developer Program. See the FAQ. You do not need to register to read the forums.

After that, you can access Nsight Systems Forums and the NVIDIA Bug Tracking System.

To submit feedback directly from the GUI, go to **Help->Send Feedback** and fill out the form. Enter your email address if you would like to hear back from the Nsight Systems team.


NVIDIA Nsight Systems
Feedback for NVIDIA Nsight Systems
Feature Suggestion
Comments:
Please enter your feedback here...
Include System Info
Include Screenshots
Attach Additional Files:
Contact Information:
Name:
Email:
By providing your email, you agree that NVIDIA may contact you regarding this feedback. Information you upload will only be used for the purpose of improving NVIDIA software. Please do not include any personal data in your uploads. If you have provided your email, you may request to delete your feedback at devtools-support@nvidia.com at any time.
Send
Cancel