



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 (.qdstm) 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.

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 cpu**. When long options are used, the switch should be followed by an equal sign and then the parameter(s); e.g. **--sample=cpu**.

For this version of Nsight Systems, you must launch a process from the command line to begin analysis. If an instance of the requested process is already running when the CLI command is issued, the collection will fail. The launched process will be terminated when collection is complete unless the user specifies the **--kill none** option (details below).

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
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.
start	Start a collection in interactive mode. The start command can be executed before or after a launch command.
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.
cancel	Cancels an existing collection started in interactive mode. All data already collected in the current collection is discarded.

Command	Description
launch	In interactive mode, launches an application in an environment that supports the requested options. The launch command can be executed before or after a start command.
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
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.
stats	Post process existing Nsight Systems result, either in .nsys-rep or SQLite format, to generate statistical information.
analyze	Post process existing Nsight Systems result, either in .nsys-rep or SQLite format, to generate expert systems report.
status	Reports on the status of a CLI-based collection or the suitability of the profiling environment.
sessions	Gives information about all sessions running on the system.
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.

1.3.1. 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
-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, 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 API will also be traced. If the none option is selected, no APIs are traced and no other API can be selected.

Short	Long	Possible Parameters	Default	Switch Description
				Note: cublas, cudnn, nvvideo, opengl, and vulkan are not available on IBM Power target.
	--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 you are using a different MPI implementation, see Tracing MPI API calls section below. Calling --mpi-impl without --trace=mpi is not supported.
-s	--sample	cpu, none	cpu	Select whether or not to collect CPU samples. If none is selected, sampling is disabled. Note: Thread scheduling information will still be collected unless --cpuctxsw switch is set to none.
	--cpuctxsw	process-tree, none	process-tree	Trace OS thread scheduling activity. Select 'none' to disable tracing

Short	Long	Possible Parameters	Default	Switch Description
				CPU context switches.
	--sampling-period	integers between 4000000 and 125000	1000000	The number of CPU Instructions Retired events counted before a CPU instruction pointer (IP) sample is collected. If configured, call stacks may also be collected. The smaller the sampling period, the higher the sampling rate. Note that lower sampling periods will increase overhead and significantly increase the size of the result file(s). This option is only supported for 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

Short	Long	Possible Parameters	Default	Switch Description
				is supported only for QNX, Linux for Tegra, and Windows 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 in Nsight Systems Embedded Platforms Edition only.
-b	--backtrace	fp,lbr,dwarf,none	lbr	Select the backtrace method to use while sampling. The option lbr uses Intel(c) Corporation's Last Branch Records, 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

Short	Long	Possible Parameters	Default	Switch Description
				(Call Frame Information).
	--command-file	< filename >	none	Open a file that contains profile 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.
-y	--delay	< seconds >	0	Collection start delay in seconds.
-d	--duration	< seconds >	NA	Collection duration in seconds, duration must be greater than zero. Note that the profiler does not detach from the application, it lives until application termination.
-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

Short	Long	Possible Parameters	Default	Switch Description
				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 outlined below. This switch can be used multiple times to add multiple providers. Note: Only available for Windows targets.
	--osrt-threshold	< nanoseconds >	1000 ns	Set the minimum time that a OS Runtime event must take before it is collected. Setting this value too low can cause high application overhead and seriously increase the size of your results file. Note: Not available for IBM Power targets.
	--osrt-backtrace-depth	integer	24	Set the depth for the backtraces

Short	Long	Possible Parameters	Default	Switch Description
				collected for OS runtime libraries calls.
	<code>--osrt-backtrace-threshold</code>	nanoseconds	80000	Set the duration, in nanoseconds, that all OS runtime libraries calls must execute before backtraces are collected.
	<code>--cudabacktrace</code>	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 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).

Short	Long	Possible Parameters	Default	Switch Description
				Note: CPU sampling must be enabled. Note: Not available on IBM Power targets.
	--cuda-flush-interval	milliseconds	0	Set the interval, in milliseconds, when buffered CUDA data is automatically saved to storage. Immediately before data is saved to storage, a <code>cudaDeviceSynchronize</code> call is inserted into the workflow which will cause application overhead. If data is not periodically saved, <code>nsys</code> will dynamically allocate memory as needed to store data during collection. For collections over 30 seconds an interval of 10 seconds is recommended.
	--cuda-memory-usage	true, false	false	Track the GPU memory usage by CUDA kernels. Applicable only

Short	Long	Possible Parameters	Default	Switch Description
				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 that this feature may cause significant runtime overhead.
	--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.
-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

Short	Long	Possible Parameters	Default	Switch Description
				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 be substituted with %. Default is report#. {qdstm,nsys-rep,sqlite} in the working directory.
	--export	sqlite, none	none	Create additional output file(s) based on the data collected. Current options are sqlite or none. WARNING: If the collection captures a large amount of data, creating the database file may take several minutes to complete.
	--stats	true, false	false	Generate summary statistics after

Short	Long	Possible Parameters	Default	Switch Description
				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.
-f	--force-overwrite	true, false	false	If true, overwrite all existing result files with same output filename (.qdstm, .nsysrep, .sqlite)
-w	--show-output	true, false	true	If true, send target process' stdout and stderr streams to the console.
-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.

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.
	--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.
	--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

Short	Long	Possible Parameters	Default	Switch Description
				undefined behavior and might cause your application to crash or deadlock. Note: Not available for Windows targets.
-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.
	--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

Short	Long	Possible Parameters	Default	Switch Description
				<p>end. Any subsequent capture ranges will be ignored. Target app will continue running.</p> <p>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.</p> <p>If repeat-shutdown:N, same behavior as repeat:N but session will be shutdown after N ranges.</p> <p>For stop-shutdown and repeat-shutdown:N, use --kill option</p>

Short	Long	Possible Parameters	Default	Switch Description
				to specify whether target app should be terminated when shutting down session.
	--stop-on-range-end	true,false	true	Stop profiling when the capture range ends. Applicable only when used along with --capture-range option. WARNING: This switch has been deprecated and will be removed in a future version.
-p	--nvtx-capture	range@domain,range,range@		Specify NVTX capture range. See below for details. This option is applicable only when used along with --capture-range=nvtx.
	--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

Short	Long	Possible Parameters	Default	Switch Description
				on IBM Power targets.
	--ftrace-keep-user-config			Skip initial ftrace setup and collect already configured events. Default resets the ftrace configuration.
	--vsync	true, false	false	Collect vsync events. If collection of vsync events is enabled, display/display_scanline ftrace events will also be captured.
	--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 <code>DXGIDeclareAdapterRemovalSupport</code> before device creation. Requires DX11 or DX12 trace to be enabled.
	--gpuctxsw	true,false	false	Trace GPU context switches. Note that this requires driver r435.17 or later and root permission. Not available

Short	Long	Possible Parameters	Default	Switch Description
				on IBM Power targets.
	<code>--gpu-metrics-device</code>	GPU ID, help, none	none	Collect GPU Metrics from specified devices. Determine GPU IDs by using <code>--gpu-metrics-device=help</code> switch.
	<code>--gpu-metrics-frequency</code>	integer	10000	Specify GPU Metrics sampling frequency. Minimum supported frequency is 10 (Hz). Maximum supported frequency is 200000(Hz).
	<code>--gpu-metrics-set</code>	index	first	Specify metric set for GPU Metrics sampling. The argument must be one of indices reported by <code>--gpu-metrics-set=help</code> switch. Default is the first metric set that supports selected GPU.
	<code>--kill</code>	none, sigkill, sigterm, signal number	sigterm	Send signal to the target application's process group.
	<code>--session-new</code>	[a-Z][0-9,a-Z,spaces]	profile- <code><id></code> - <code><application></code>	Name the session created by the

Short	Long	Possible Parameters	Default	Switch Description
				command. Name must start with an alphabetical character followed by printable or space characters. Any <code>%q{ENV_VAR}</code> pattern will be substituted with the value of the environment variable. Any <code>%h</code> pattern will be substituted with the hostname of the system. Any <code>%</code> pattern will be substituted with <code>%</code> .
	<code>--retain-etw-files</code>	true, false	false	If true, retains ETW files generated by the trace, merges and moves the files to the output directory.
	<code>--opengl-gpu-workload</code>	true, false	true	If true, trace the OpenGL workloads' GPU activity. Note that this switch is applicable only when <code>--trace=opengl</code> is specified. This option is not supported

Short	Long	Possible Parameters	Default	Switch Description
				on IBM Power targets.
	--vulkan-gpu-workload	true, false	true	If true, trace the Vulkan workloads' GPU activity. Note that this switch is applicable only when --trace=vulkan is specified. This option is not supported on QNX.
	--dx12-gpu-workload	true, false	true	If true, trace the 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	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.

Short	Long	Possible Parameters	Default	Switch Description
	--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.
	--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.
	--cpu-core-events	0x11,0x13,...,none	%s	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. Available in Nsight Systems Embedded

Short	Long	Possible Parameters	Default	Switch Description
				Platforms Edition only.
	--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-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-cluster-events=help switch to see the full list of values. Available in Nsight Systems Embedded Platforms Edition only.
	--process-scope	main, process-tree, system-wide	main	Select which process(es) to trace. Available in Nsight Systems

Short	Long	Possible Parameters	Default	Switch Description
				Embedded Platforms Edition only. Nsight Systems Workstation Edition will always trace system-wide in this version of the tool.
	--accelerator-trace	none, nvmedia	none	Collect other accelerators workload trace from the hardware engine units. Available in Nsight Systems Embedded Platforms Edition only.
	--clock-frequency-changes	true, false	false	Collect clock frequency changes. 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.
	--el1-sampling	true, false	false	Enable EL1 sampling. Available in Nsight Systems Embedded Platforms Edition only.

Short	Long	Possible Parameters	Default	Switch Description
	<code>--el1-sampling-config</code>	< filepath config.json >	none	EL1 sampling config. Available in Nsight Systems Embedded Platforms Edition only.

1.3.2. 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
<code>-c</code>	<code>--capture-range</code>	none, cudaProfilerApi, hotkey, nvtx	none	When <code>--capture-range</code> is used, profiling will start only when appropriate start API or hotkey is invoked. If <code>--capture-range</code> is set to none, start/stop API calls and hotkeys will be ignored. Note: hotkey works for graphic applications only.
<code>-o</code>	<code>--output</code>	< filename >	report#	Set report file name. Any <code>%q{ENV_VAR}</code> pattern in the filename will be substituted with the value of the environment variable. Any <code>%h</code>

Short	Long	Possible Parameters	Default	Switch Description
				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 be substituted with %. Default is report#. {qdstm,nsys-rep,sqlite} in the working directory.
	--export	sqlite, hdf, text, json, none	none	Create additional output file(s) based on the data collected. WARNING: If the collection captures a large amount of data, creating the export file may take several minutes to complete.
	--stats	true, false	false	Generate summary statistics after the collection. WARNING: When set to

Short	Long	Possible Parameters	Default	Switch Description
				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.
-f	--force-overwrite	true, false	false	If true, overwrite all existing result files with same output filename (.qdstm, .nsys-rep, .sqlite)
-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.
	--capture-range-end	none, stop, stop-shutdown, repeat[:N],	stop-shutdown	Specify the desired behavior when

Short	Long	Possible Parameters	Default	Switch Description
		repeat-shutdown:N		<p>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. Any subsequent capture ranges will be ignored once N capture ranges are</p>

Short	Long	Possible Parameters	Default	Switch Description
				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 , use --kill option to specify whether target app should be terminated when shutting down session.
	--stop-on-range-end	true,false	true	Stop profiling when the capture range ends. Applicable only when used along with --capture-range option. WARNING: This switch has been deprecated and will be removed in a future version.
	--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

Short	Long	Possible Parameters	Default	Switch Description
				file as as outlined below. This switch can be used multiple times to add multiple providers. Note: Only available for Windows targets.
	--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.
	--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 supported on IBM Power targets.
	--ftrace-keep-user-config			Skip initial ftrace setup and collect already

Short	Long	Possible Parameters	Default	Switch Description
				configured events. Default resets the ftrace configuration.
	<code>--gpu-metrics-device</code>	GPU ID, help, none	none	Collect GPU Metrics from specified devices. Determine GPU IDs by using <code>--gpu-metrics-device=help</code> switch.
	<code>--gpu-metrics-frequency</code>	integer	10000	Specify GPU Metrics sampling frequency. Minimum supported frequency is 10 (Hz). Maximum supported frequency is 200000(Hz).
	<code>--gpu-metrics-set</code>	index	first	Specify metric set for GPU Metrics sampling. The argument must be one of indices reported by <code>--gpu-metrics-set=help</code> switch. Default is the first metric set that supports selected GPU.
	<code>--gpuctxsw</code>	true,false	false	Trace GPU context switches. Note that this requires driver

Short	Long	Possible Parameters	Default	Switch Description
				r435.17 or later and root permission. Not supported on IBM Power targets.
	--session	session identifier	none	Start 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 %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

Short	Long	Possible Parameters	Default	Switch Description
				<code>%q{ENV_VAR}</code> pattern will be substituted with the value of the environment variable. Any <code>%h</code> pattern will be substituted with the hostname of the system. Any <code>%</code> pattern will be substituted with <code>%</code> .
	<code>--vsync</code>	true, false	false	Collect vsync events. If collection of vsync events is enabled, display/display_scanline/fttrace events will also be captured.
	<code>--process-scope</code>	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.
	<code>--accelerator-trace</code>	none, nvmedia	none	Collect other accelerators workload trace from the hardware

Short	Long	Possible Parameters	Default	Switch Description
				engine units. Available in Nsight Systems Embedded Platforms Edition only.
	--clock-frequency-changes	true, false	false	Collect clock frequency changes. 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.
	--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.

1.3.3. 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
	--session	session identifier	none	Stop the indicated session. The option argument must represent a valid session name or ID as reported by nsysessions 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 % .

1.3.4. 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
	--session	session identifier	none	Cancel the indicated session. The option argument must represent a valid session name or ID as reported by nsysessions list . Any %q{ENV_VAR}

Short	Long	Possible Parameters	Default	Switch Description
				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 %.

1.3.5. 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
-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, 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

Short	Long	Possible Parameters	Default	Switch Description
				<p>markers will be automatically collected when DX or vulkan API trace is enabled. See information on <code>--mpi-impl</code> option below if <code>mpi</code> is selected. If '<code><api>-annotations</code>' is selected, the corresponding API will also be traced. If the <code>none</code> option is selected, no APIs are traced and no other API can be selected. Note: <code>cublas</code>, <code>cuda</code>, <code>nvvideo</code>, <code>opengl</code>, and <code>vulkan</code> are not available on IBM Power target.</p>
	<code>--mpi-impl</code>	<code>openmpi,mpich</code>	<code>openmpi</code>	<p>When using <code>--trace=mpi</code> to trace MPI APIs use <code>--mpi-impl</code> to specify which MPI implementation the application is using. If you are using a different MPI implementation, see Tracing MPI API calls section below. Calling <code>--mpi-impl</code> without <code>--</code></p>

Short	Long	Possible Parameters	Default	Switch Description
				trace=mpi is not supported.
-s	--sample	cpu, none	cpu	Select whether or not to collect CPU samples. If none is selected, sampling is disabled. Note: Thread scheduling information will still be collected unless --cpuctxsw switch is set to none.
	--cpuctxsw	process-tree, none	process-tree	Trace OS thread scheduling activity. Select 'none' to disable tracing CPU context switches.
	--sampling-period	integers between 4000000 and 125000	1000000	The number of CPU Instructions Retired events counted before a CPU instruction pointer (IP) sample is collected. If configured, call stacks may also be collected. The smaller the sampling period, the higher the sampling rate. Note that lower sampling periods will increase

Short	Long	Possible Parameters	Default	Switch Description
				overhead and significantly increase the size of the result file(s). This option is available only on 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.
-b	--backtrace	fp,lbr,dwarf,none	lbr	Select the backtrace method to use while sampling. The option lbr uses Intel(c) Corporation's Last Branch Records, available only with Intel(c) CPUs codenamed Haswell and later. The option fp is frame pointer and assumes

Short	Long	Possible Parameters	Default	Switch Description
				that frame pointers were enabled during compilation. The option dwarf uses DWARF's CFI (Call Frame Information).
	--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.
-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.
	--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,

Short	Long	Possible Parameters	Default	Switch Description
				provide a JSON configuration file as outlined below. This switch can be used multiple times to add multiple providers. Note: Only available for Windows targets.
	--osrt-threshold	< nanoseconds >	1000 ns	Set the minimum time that a OS Runtime event must take before it is collected. Setting this value too low can cause high application overhead and seriously increase the size of your results file. Note: Not available for IBM Power targets.
	--osrt-backtrace-depth	integer	24	Set the depth for the backtraces collected for OS runtime libraries calls.
	--osrt-backtrace-threshold	nanoseconds	80000	Set the duration, in nanoseconds, that all OS runtime libraries calls must

Short	Long	Possible Parameters	Default	Switch Description
				execute before backtraces are collected.
	--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 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-flush-interval	milliseconds	0	Set the interval, in milliseconds, when buffered

Short	Long	Possible Parameters	Default	Switch Description
				CUDA data is automatically saved to storage. Immediately before data is saved to storage, a <code>cudaDeviceSynchronize</code> call is inserted into the workflow which will cause application overhead. If data is not periodically saved, <code>nsys</code> will dynamically allocate memory as needed to store data during collection. For collections over 30 seconds an interval of 10 seconds is recommended.
	<code>--cuda-memory-usage</code>	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.
	<code>--cuda-um-cpu-page-faults</code>	true, false	false	This switch tracks the page

Short	Long	Possible Parameters	Default	Switch Description
				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.
	--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.
-w	--show-output	true, false	true	If true, send target process' stdout and stderr streams to the console
-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

Short	Long	Possible Parameters	Default	Switch Description
				the launched process.
-p	--nvtx-capture	message@idomain	none	Specify NVTX capture range. See below for details.
	--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: Not available for Windows targets.
	--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.
	--session	session identifier	none	Launch the application in the indicated session. The option argument must

Short	Long	Possible Parameters	Default	Switch Description
				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 % .
	--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

Short	Long	Possible Parameters	Default	Switch Description
				be substituted with %.
	--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.
	--vulkan-gpu-workload	true, false	true	If true, trace the Vulkan workloads' GPU activity. Note that this switch is applicable only when --trace=vulkan is specified. This option is not supported on QNX.
	--dx12-gpu-workload	true, false	true	If true, trace the DX12 workloads' GPU activity. Note that this switch is applicable only when --trace=dx12 is specified. This option is only supported on Windows targets.

Short	Long	Possible Parameters	Default	Switch Description
	<code>--dx12-wait-calls</code>	true, false	true	If true, trace wait calls that block on fences for DX12. Note that this switch is applicable only when <code>--trace=dx12</code> is specified. This option is only supported on Windows targets.
	<code>--wddm-additional-events</code>	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 <code>--trace=wddm</code> is specified. This option is only supported on Windows targets.
	<code>--hotkey-capture</code>	'F1' to 'F12'	'F12'	Hotkey to trigger the profiling session. Note that this switch is applicable only when <code>--capture-range=hotkey</code> is specified.
	<code>--cpu-core-events</code>	0x11,0x13,...,none	%s	Collect per-core PMU counters.

Short	Long	Possible Parameters	Default	Switch Description
				Multiple values can be selected, separated by commas only (no spaces). Use the <code>--cpu-core-events=help</code> switch to see the full list of values. Available in Nsight Systems Embedded Platforms Edition only.
	<code>--cpu-cluster-events</code>	0x16, 0x17, ..., none	none	Collect per-cluster Uncore PMU counters. Multiple values can be selected, separated by commas only (no spaces). Use the <code>--cpu-cluster-events=help</code> switch to see the full list of values. Available in Nsight Systems Embedded Platforms Edition only.
	<code>--cpu-socket-events</code>	0x2a, 0x2c, ..., none	none	Collect per-socket Uncore PMU counters. Multiple values can be selected, separated by commas only (no spaces). Use the <code>--cpu-cluster-events=help</code>

Short	Long	Possible Parameters	Default	Switch Description
				switch to see the full list of values. Available in Nsight Systems Embedded Platforms Edition only.

1.3.6. 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
	--kill	none, sigkill, sigterm, signal number	sigterm	Send signal to the target application's process group.
	--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 %

Short	Long	Possible Parameters	Default	Switch Description
				% pattern will be substituted with %.

1.3.7. 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
-o	--output	<filename>	<inputfile.ext>	Set the .output filename. The default is the .nsys-rep filename with the extension for the chosen format.
-t	--type	sqlite, hdf, text, json, info	sqlite	Export format type. HDF format is supported only on x86_64 Linux and Windows
-f	--force-overwrite	true, false	false	If true, overwrite existing result file
-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

Short	Long	Possible Parameters	Default	Switch Description
				and HDF5 exports only.
-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.

1.3.8. 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-reports	<report_name>, ALL, [none]	none	With no argument, give a summary of the available summary and trace reports. If 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.
	--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.
	--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

Short	Long	Possible Parameters	Default	Switch Description
				from the specified .nsys-rep file before report processing. This option cannot be used if the specified input file is also an SQLite file.
-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: cudaapisum, gpukernsum, gpumemtimesum, gpumemsizesum, osrtsum, nvtxppsum, openmpevtsum. See Report Scripts section for details about existing built-in scripts and how to make your own.

Short	Long	Possible Parameters	Default	Switch Description
-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 Scripts for options available with each format.
-o	--output	-, @<command>, <basename>, .	-	Specify the output mechanism for the corresponding reports(s). There are three output mechanisms: print to console (-), output to command (@<command>),

Short	Long	Possible Parameters	Default	Switch Description
				or output to file (<basename>). The option "." can be used to specify using the default basefile, which is the basename of the input file. The filename used will be <basename>_<report&args>.<ou
	--report-dir			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. The last two entries in the path will always be the current working directory, followed by the directory containing the shipped nsys reports.
	--force-export	true, false	false	Force a re-export of the SQLite file from the specified .nsys-rep file, even if

Short	Long	Possible Parameters	Default	Switch Description
				an SQLite file already exists.
	--force-overwrite	true, false	false	Overwrite any existing report file(s).
-q	--quiet			Only display errors.

1.3.9. 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
-h	--help			Print help message.
	--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 more detailed explanation of all available rules is displayed.
	--sqlite	<file.sqlite>		Specify the SQLite export filename. If this file exists, it will

Short	Long	Possible Parameters	Default	Switch Description
				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.
-r	--rule	asyn-memcpy-pageable, sync-memcpy, sync-memset, sync-api, gpu-starvation, gpu-low-utilization	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 for details on all rules.
	--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.
-q	--quiet			Do not display verbose messages.

1.3.10. CLI Status Command Switch Options

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

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

Short	Long	Possible Parameters	Default	Switch Description
	<none>			Returns current state of the CLI.
-e	--environment			Returns information about the system regarding suitability of the profiling environment.
	--session	session identifier	none	Print the status of the indicated session. The option argument must represent a valid session name or ID as reported by nsysessions 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 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

1.4. Example Single Command Lines

Version Information

```
nsys -v
```

Effect: Prints tool version information to the screen.

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 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.

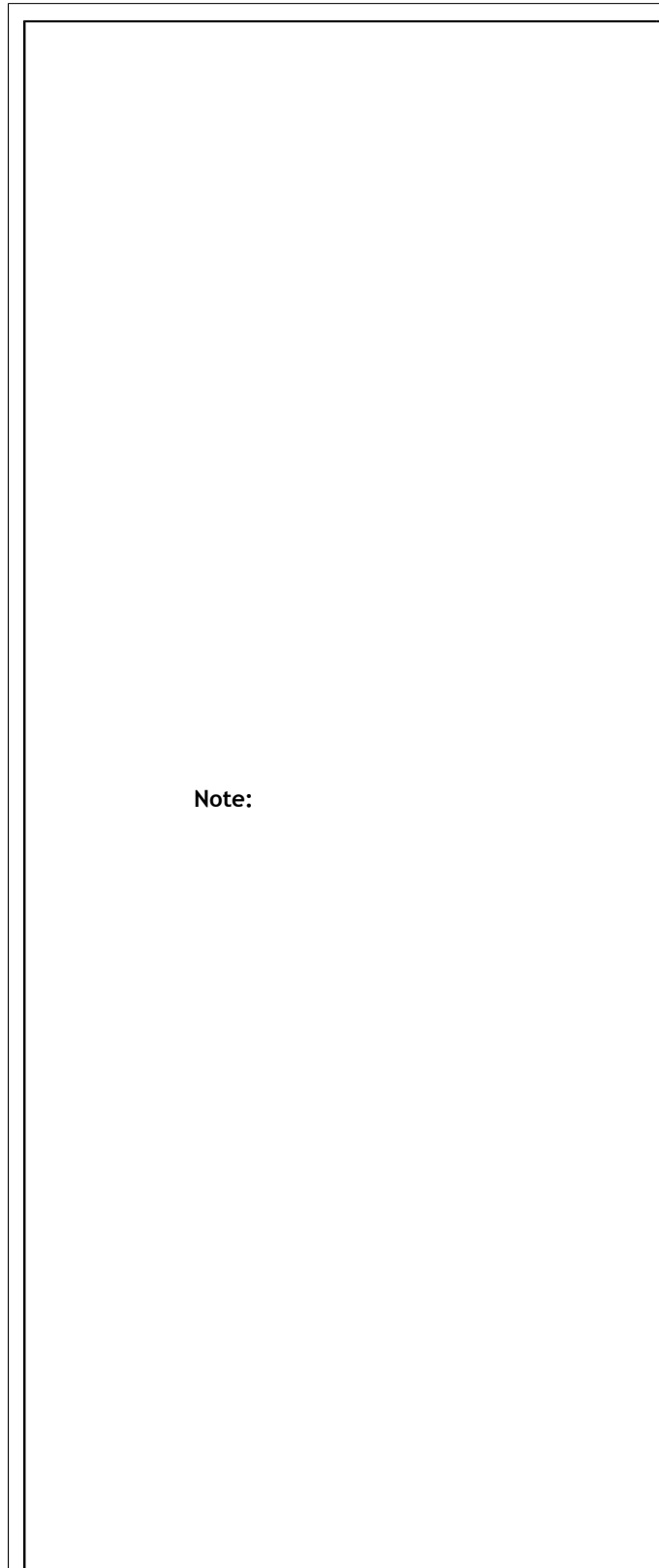
1.5. Example Interactive CLI Command Sequences

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:

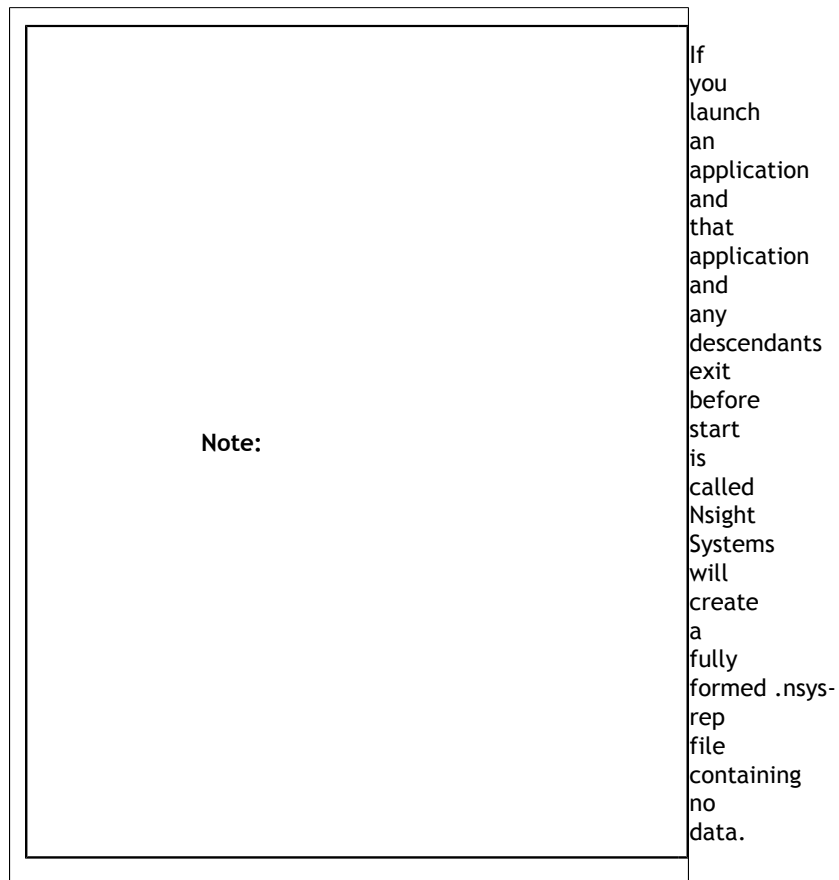
If you start a collection and fail to stop the collection (or if you are allowing it to stop on exit, and the application runs for too long) your system's storage space may be filled with collected data causing significant issues for the system. Nsight Systems will collect a different amount of data/sec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



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.



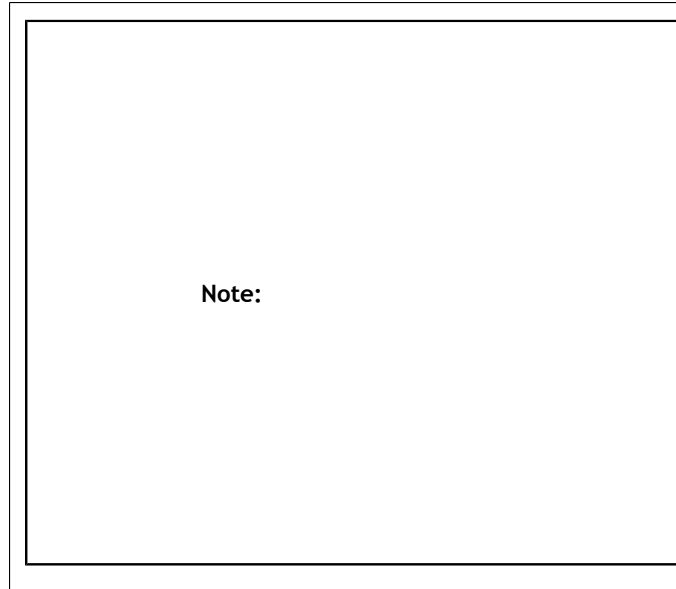
Run application, start/stop collection using cudaProfilerStart/Stop

```
nsys start -c cudaProfileApi
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.

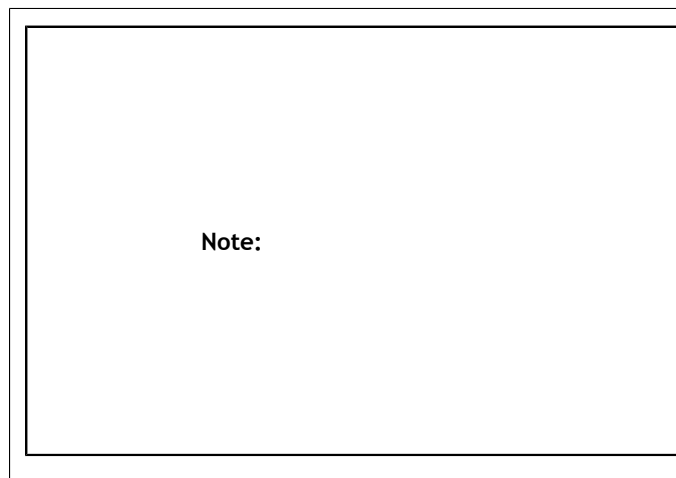


The Nsight Systems CLI does not support multiple calls to the `cudaProfilerStart/Stop` API at this time.

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.



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:

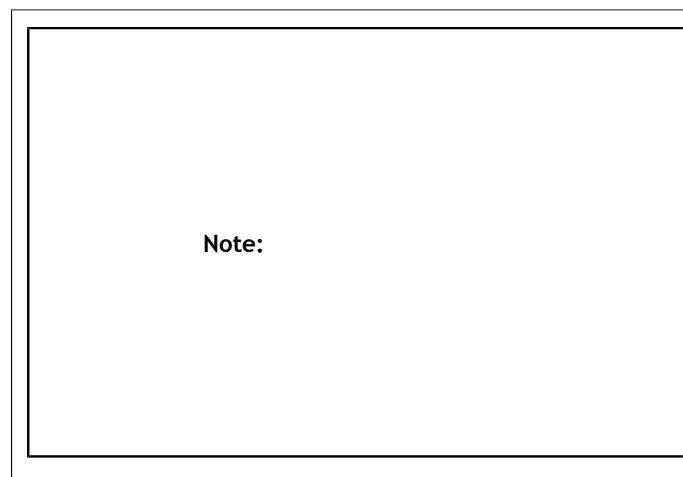
```
nsys launch -w true -p profiler@service -e
NSYS_NVTX_PROFILER_REGISTER_ONLY=0 ./app
```

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	freed
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\Quad-Release\target-windows-x64\reports\vulkanmarkersum.py D:\src\output_host\Built\Bin\Quad-Release\target-windows-x64\marker_test\ued_infiltrator_vulkan_markers.sqlite]...
```

Time (%)	Total Time (ns)	Instances	Average (ns)	Minimum (ns)	Maximum (ns)	StdDev	Range
37.2	2339018401	136	17169252.9	13692647	28504631	2729172.8	SendAllEndOfFrameUpdates
10.7	670882802	137	4891115.3	1711561	283744644	24611148.8	BasePass
5.0	311897629	1507	206965.9	6198	3407757	215626.1	BeginRenderingGBuffer
3.2	198278698	1644	120408.1	3128	952434	152228.7	BeginRenderingTranslucency
3.0	186977118	137	1364796.5	1066597	4088690	395358.6	Lights
3.0	186626496	137	1362237.2	1064426	4084894	395189.6	DirectLighting
1.7	104681274	137	764896.9	592935	2807777	238923.8	NonShadowedLights
1.5	95597952	136	702926.1	538868	1944515	269677.7	PostProcessing
1.4	85538857	137	624334.7	432949	2359711	243159.6	PrePass DDM_Allopaque (Forced by DBuffer)
1.3	83827427	2820	29726.0	1514	755373	43994.7	BeginRenderingPrePass
1.3	81222414	137	592871.6	441855	1876511	188289.9	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	16488	2145669	291073.5	BeginSeparateTranslucency
1.0	61329202	19591	3139.5	1228	319829	4991.0	M_FogSheetMaster_SQ_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	314094.5	231792	1002868	103224.0	InjectNonShadowedTranslucentLighting
0.6	34849986	136	255249.3	193556	897954	92451.7	DOF (AlphaNo)
0.6	37774169	96	393489.9	323526	550130	37746.8	UpdatedPUScene 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	34849986	136	255249.3	193556	897954	92451.7	DOF (AlphaNo)
0.5	32798709	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	28556	242351	30492.3	ShadowProjectionOnOpaque
0.4	24154169	136	177494.2	130608	596779	80681.5	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	22779580	6850	3325.5	1493	203231	4384.5	Environment_Mire_MASTER_SK_Mire_02
0.3	21170479	137	154594.7	107090	1582286	133950.6	ViewOcclusionTests 0
0.3	21058892	274	76857.3	13489	447949	74050.6	VIS_ArtDemo_Screw_SM_Infill_Underground_Pipe01_439
0.3	20154748	137	147444.1	104452	174719	149998.6	ShadowDepth
0.3	19368869	410	47241.1	5325	435358	62128.4	VelocityRendering
0.3	18867829	137	137721.4	100037	1745961	146450.6	Atlas@ 2048x2048
0.3	17336627	820	21142.2	10371	119580	13048.1	InjectTranslucentVolume
0.3	17278244	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	15915	364140	49448.6	VIS_ArtDemo_Screw_SpotLightStationary_30
0.2	15147425	685	19193.3	10046	309402	16959.9	ShadowMapClasses
0.2	14261554	136	94310.0	69204	1395919	109278.5	Distortion
0.2	12029306	821	14652.0	8142	237658	13625.1	Skinning000 Chunk@ InStreamStart@ OutStart@ Vert@8021 Morph@0
0.2	11313758	2740	4129.1	1377	54848	4497.1	M_CloudSheetMaster_EditorPlane
0.2	11120776	335	82374.6	61380	311120	33641.8	VIS_ArtDemo_Keyhole_SpotLightStationary_2
0.2	10845277	1507	7196.6	3515	174162	6173.2	@Buffer
0.2	10647885	25	425915.4	338156	962796	122138.9	UpdatedPUScene 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

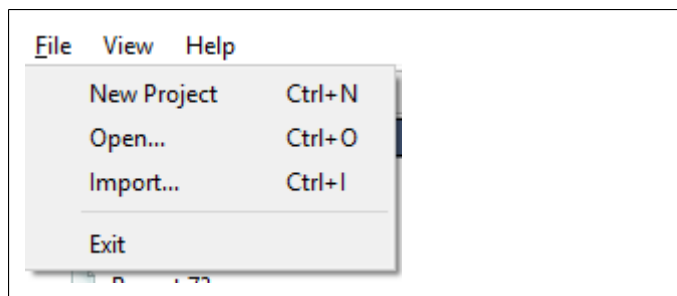
The CLI generates a .qdstrm file. The .qdstrm file is an intermediate result file, not intended for multiple imports. It needs to be processed, either by importing it into the GUI or by using the standalone QdstrmImporter to generate an optimized .nsys-rep file. Use this .nsys-rep file when re-opening 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 .qdstm 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 via `--trace=mpi` option only for the OpenMPI and MPICH implementations of MPI. It traces a default list of synchronous MPI APIs. If you require more control over the list of traced APIs or if you are using a different MPI implementation, see [github nvtx pmpi wrappers](#).

You can use this documentation to generate a shared object to wrap a list of synchronous MPI APIs with NVTX using the MPI profiling interface (PMPI). If you set your `LD_PRELOAD` environment variable to the path of that object, nsys will capture and report the MPI API trace information when `--trace=nvtx` is used. There is no need to use `--trace=MPI`.

NVTX tracing is automatically enabled when MPI trace is turned on.

1.9.2. Using the CLI to Profile Applications Launched with mpirun

This version of 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` command. 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.

To profile everything, putting the data in one file:

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

To profile everything putting the data from each rank into a separate file:

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

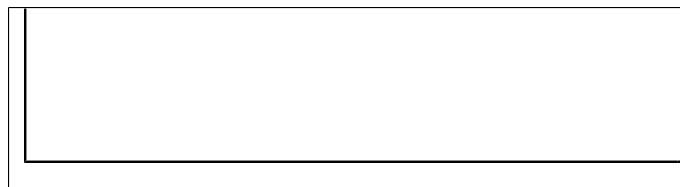

To profile a single MPI process use a wrapper script. The following script(called "wrap.sh") runs nsys on rank 0 only:

```
#!/bin/bash
if [[ $OMPI_COMM_WORLD_RANK == 0 ]]; then
~/nsys/nsys_profile ./myapp "$@" --mydummyargument
else
./myapp "$@"
fi
```

and then execute `mpirun ./wrap.sh`.

Note:

Currently you will need a dummy argument to the process, so that Nsight Systems can decide which process to profile. This means that your process must accept dummy arguments to take advantage of this workaround. This script as written is for Open MPI, but should be easily



adaptable
to
other
MPI
implementations.

Chapter 2.

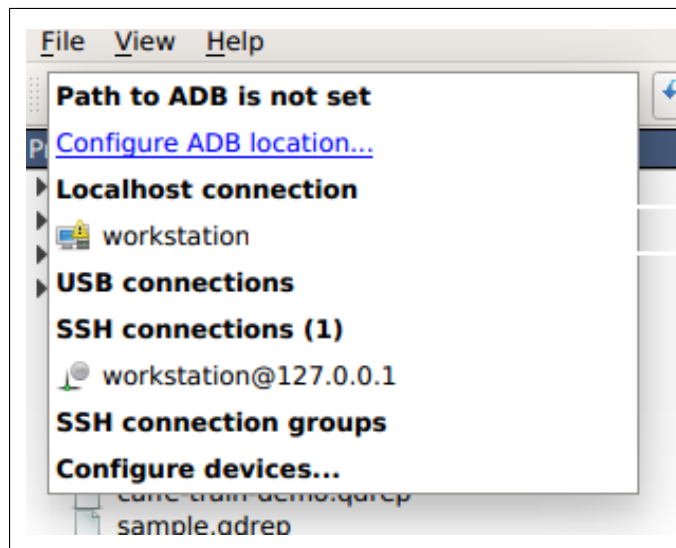
PROFILING FROM THE GUI

2.1. Profiling Linux Targets from the GUI

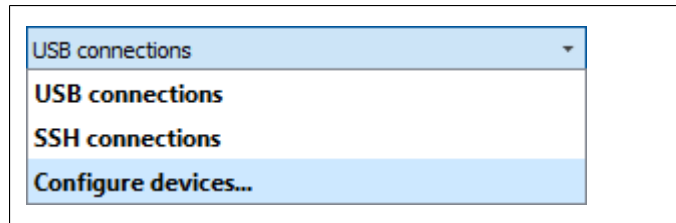
2.1.1. Connecting to the Target Device

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:

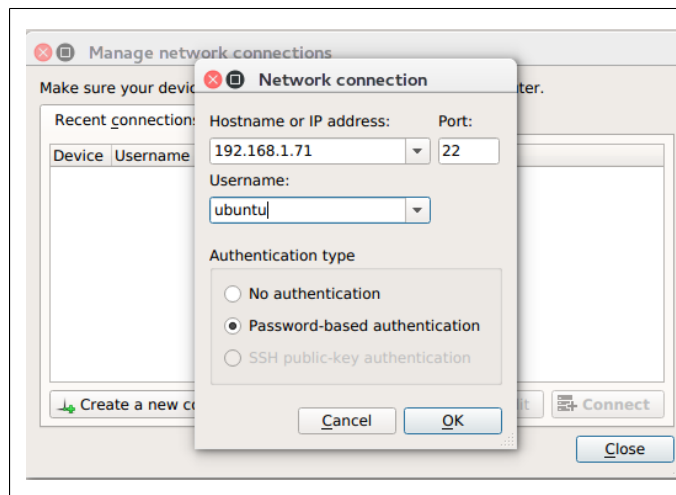
On x86_64:



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
```

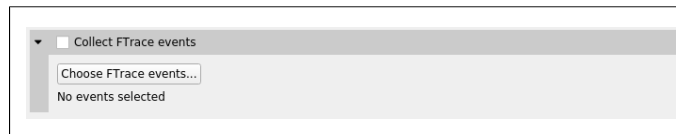
2.1.2. System-Wide Profiling Options

2.1.2.1. Linux x86_64

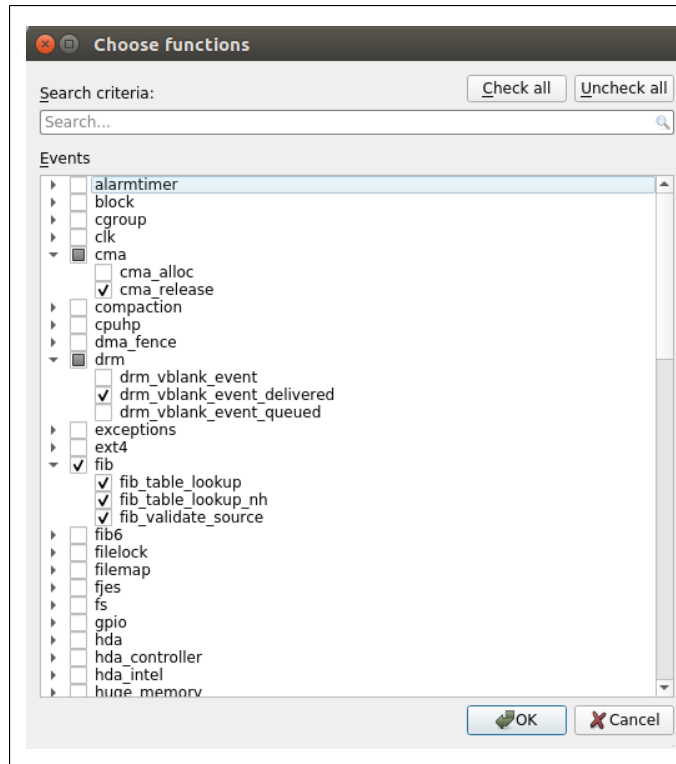
System-wide profiling is available on x86 for Linux targets only when run with root privileges.

Ftrace Events Collection

Select Ftrace events

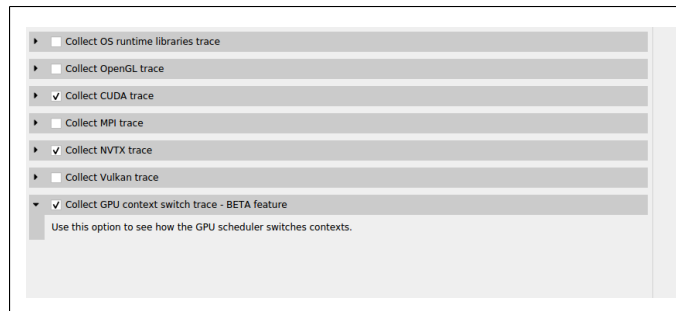


Choose which events you would like to collect.

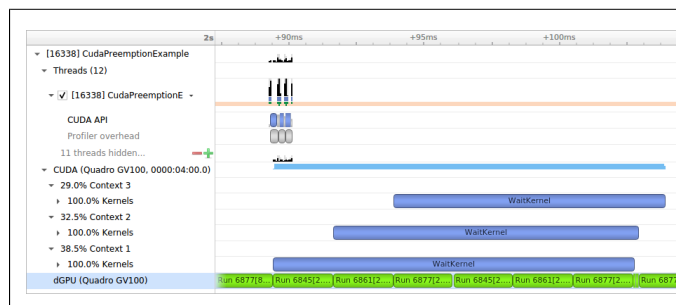


GPU Context Switch Trace

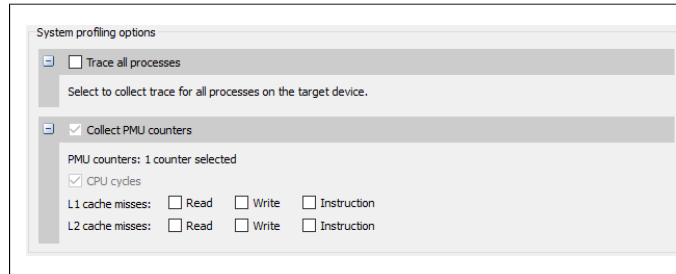
Tracing of context switching on the GPU is enabled with driver r435.17 or higher.



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



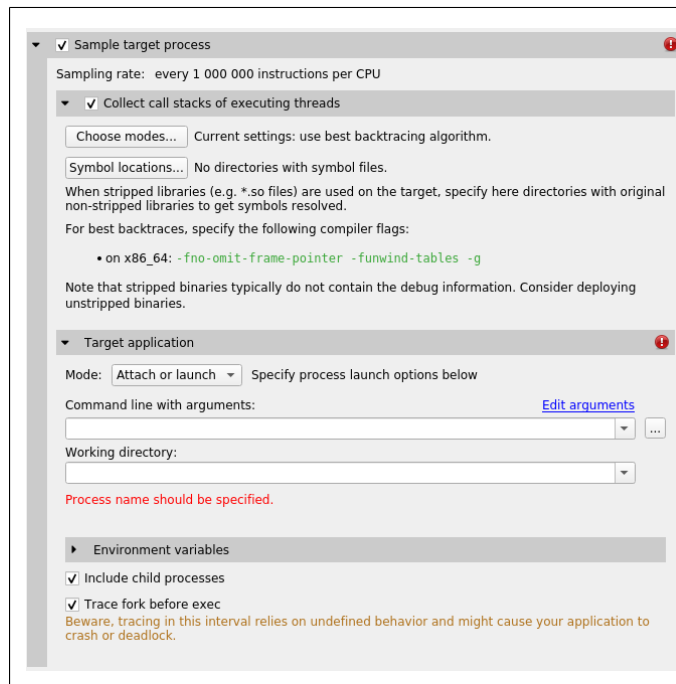
Trace all processes – On compatible devices (with kernel module support version 1.107 or higher), this enables trace of all processes and threads in the system. Scheduler events from all tasks will be recorded.

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.

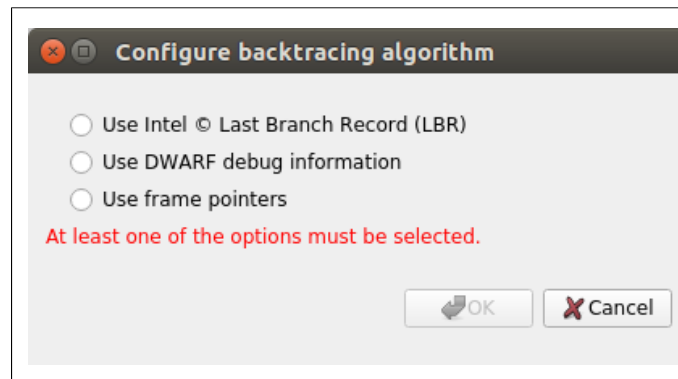
Target Sampling Options for Workstation



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.



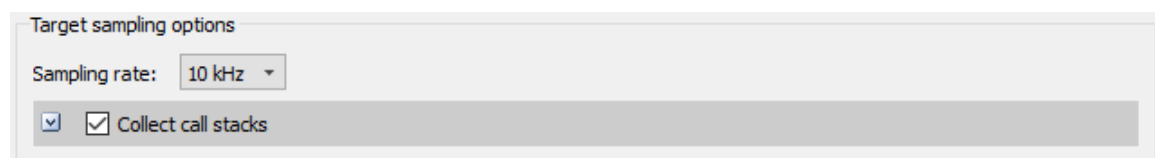
The **Include child processes** switch controls whether API tracing is only for the launched process, or for all existing and new child processes of the launched process. If you are running your application through a script, for example a bash script, you need to set this checkbox.

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



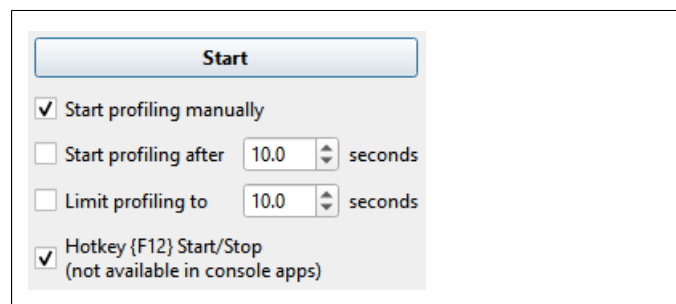
Currently Nsight Systems can only sample one process. Sampling here means that the profilee will be stopped periodically, and backtraces of active threads will be recorded.

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.

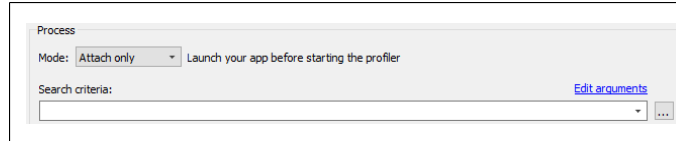
2.1.5. Launching and Attaching to Processes

Nsight Systems Embedded Platforms Edition can work with Linux-based devices in three modes:

1. Attaching to a process by name
2. Attaching to a process by name, or launching a new process
3. Attaching to a process by its PID

The purpose of the configuration here is to define which process the profiler will attach to for sampling and tracing. Additionally, the profiler can launch a process prior to attaching to it, ensuring that all environment variables are set correctly to successfully collect trace information.

In **Attach only** mode, the process is selected by its name and command line arguments, as visible using the **ps** tool.

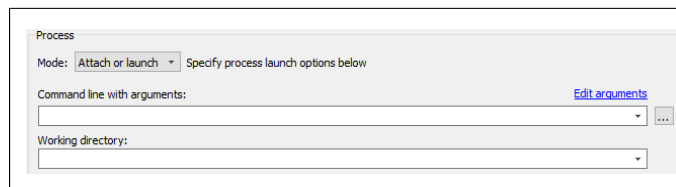


In **Attach or launch** mode, the process is first search as if in the Attach only mode, but if it is not found, the process is launched using the same path and command line arguments. If NVTX, CUDA, or other trace settings are selected, the process will be automatically launched with appropriate environment variables.

Note that in some cases, the capabilities of Nsight Systems are not sufficient to correctly launch the application; for example, if certain environment variables have to be corrected. In this case, the application has to be started manually and Nsight Systems should be used in Attach only mode.

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.

To properly populate the **Search criteria** field based on a currently running process on the target system, use the **Select a process** button on the right, which has ellipsis as the caption. The list of processes is automatically refreshed upon opening.



Attach by PID mode should be used to connect to a specific process.

To choose one of the currently running processes on the target system, use the **Select a process** button on the right.

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:

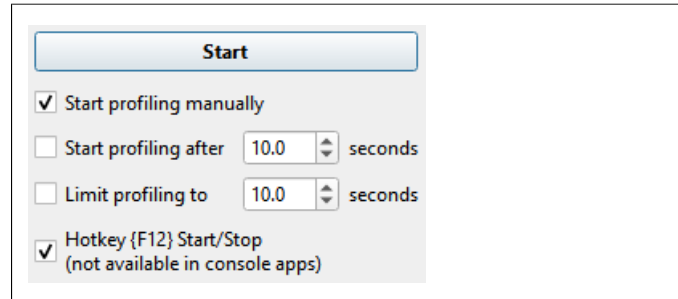
Remoting to a Windows Based Machine

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.

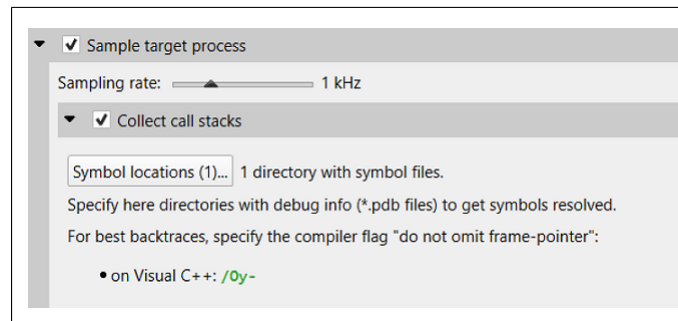
Set the decimal numeric identifier of the hotkey you would like to use for triggering start/stop from the target app graphics window. The default value is 123 which corresponds to 0x7B, or the F12 key.

Virtual key identifiers are detailed in [MSDN's Virtual-Key Codes](#).

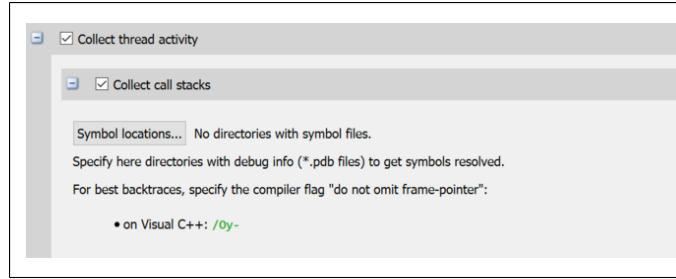
Note that you must convert the hexadecimal values detailed in this page to their decimal counterpart before using them in the file. For example, to use the F1 key as a start/stop trace hotkey, use the following settings in the config.ini file:

```
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.



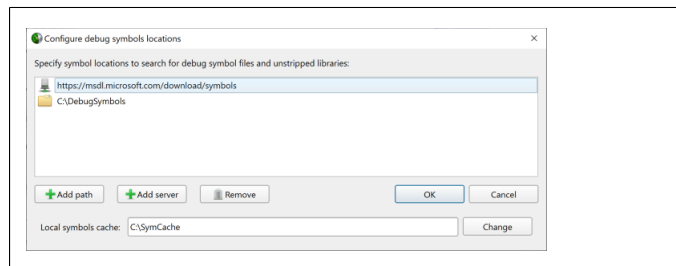
On Windows, Nsight Systems can collect thread activity of one process tree. Collecting thread activity means that each thread context switch event is logged and (optionally) a backtrace is collected at the point that the thread is scheduled back for execution. Thread states are displayed on the timeline.

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 Android Targets from the GUI

Profiling on Android 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:

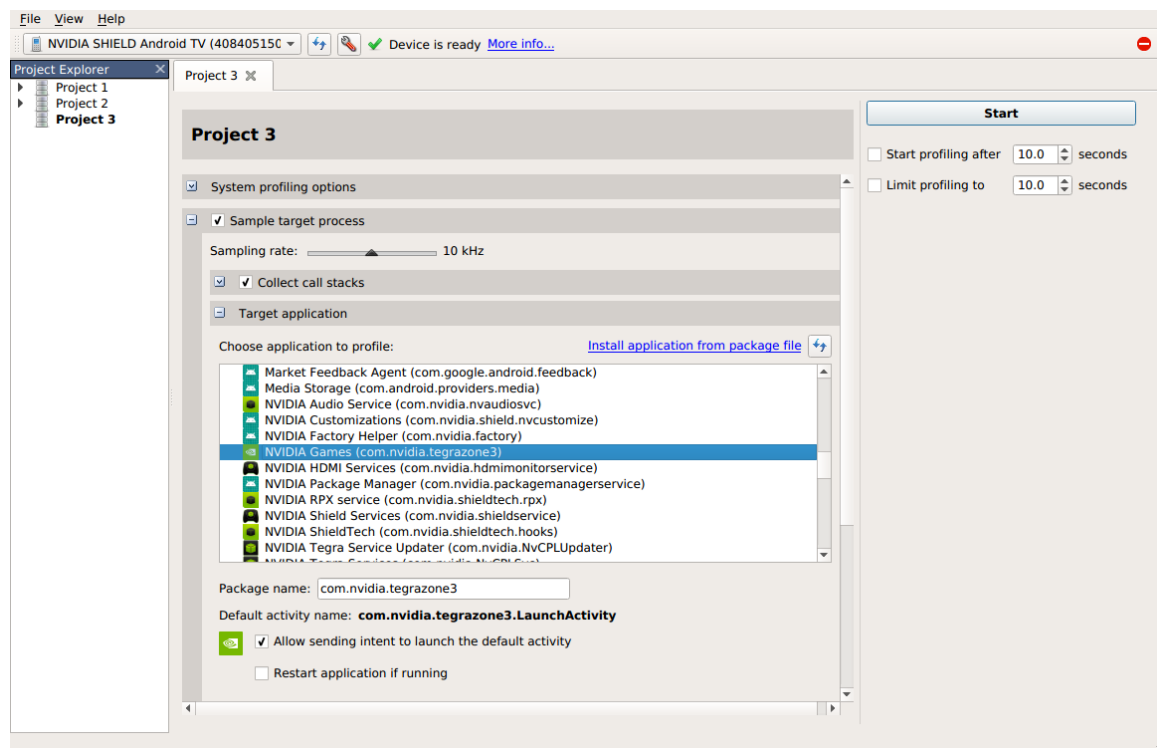
Configuring Your Android Device

To work with Nsight Systems, the target Android device should be configured for **USB debugging** in the **Developer options** settings menu. Please refer to Android development documentation to learn how to configure the device for USB debugging.

On the host, a compatible USB driver should be installed. Please refer to device manufacturer's documentation to learn how to obtain and install the driver.

Connect your target device via a USB cable and power it on (or wake it up). Make sure that you have the **adb** command available (it is part of Android SDK Platform Tools package). Nsight Systems can only connect to devices that are marked as **device** in the output of the **adb devices** command. Make sure you can enter the ADB shell of the target device by running **adb shell** on the host.

Launch the Nsight Systems application. On the first launch, a new project called **Project 1** is created automatically.



When connecting to the target device, Nsight Systems will validate it and install its daemon into the following location on the device:

```
/data/local/tmp/com.nvidia.nightsystems.tools/
```

Once the daemon and all required files are installed correctly, a green check mark will appear and **Device is ready** text will be displayed:



Application

This section allows you to choose which application to profile. All information will be collected about the main process of the selected application, except when the **Trace all processes** checkbox is enabled.

For non-rooted Android devices, the list of applications only shows information about debuggable applications. By default, applications that are being developed using the Android SDK already contain the debuggable option in their manifests.

On rooted Android devices, profiling of all applications is allowed.

For convenience, the application list also shows the process identifiers (PID) of processes correlated to the listed packages. To refresh this information, use the button in the upper right corner of the list.

The two checkboxes below the application list are important to ensure that the correct launch or attach behavior is configured.

Allow sending intent to launch the default activity, when unselected, forces the profiler to attach to a running process. If no processes are found to correlate to the specified application name, the profiling session fails to start with an error message. When selected, Nsight Systems may launch the default intent of the selected application to make sure it is running and appears on top of the screen on the target device.

In some applications, especially in early stages of development, common bugs related to handling the lifecycle of activities can be found. In such cases, sending the default intent may lead to undesired behavior or even crashes of the profilee. Leaving the checkbox unselected ensures that the profiler does not affect the application.

Restart application if running is a convenient option in two cases:

1. When profiling from the very beginning of the application is desired.
2. When using some of the trace features described below. They require that a special library is injected into the application in runtime, which happens when the application is paused by the Android runtime's virtual machine just after starting. In this case, enabling this option helps ensure that the application is always restarted and the injection always happens, as opposed to potentially attaching to the application's process without injection.

Collect NVTX trace. See [NVTX Trace](#) for more information.

Collect OpenGL trace. See [OpenGL Trace](#) for more information.

2.4. 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...** Complete documentation of the schema, with samples is installed with the product in the documentation \nsys-exporter directory.

Note: The .nsys-rep report format is the 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 directory of your Nsight Systems installation.

```
sqlite> .schema
CREATE TABLE StringIds (id INTEGER PRIMARY KEY, value TEXT NOT NULL);
CREATE TABLE SCHED_EVENTS (id INTEGER PRIMARY KEY AUTOINCREMENT, start INT NOT NULL, cpu INT NOT NULL, isSchedIn INT NOT NULL, globalTid INT NOT NULL);
CREATE TABLE sqlite_sequence(name,seq);
CREATE TABLE COMPOSITE_EVENTS (id INT NOT NULL PRIMARY KEY, start INT NOT NULL, cpu INT NOT NULL, threadState INT NOT NULL, globalTid INT NOT NULL, cpuCycles INT NOT NULL);
...
```

Note: Currently tables are created lazily 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

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 Examples section in your installed documentation directory for a list of common recipes. This may change in a future version of the product.

Due to current limitations, all fields are declared as NOT NULL, even if the actual value may be missing. If the value is missing, the cell is set to the default value for that field. This might change in future versions.

3.2. 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 `gpumemsum` 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.

gpumemsizeum -- 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 **gpumentimesum** 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=cudaProfilerApp	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.

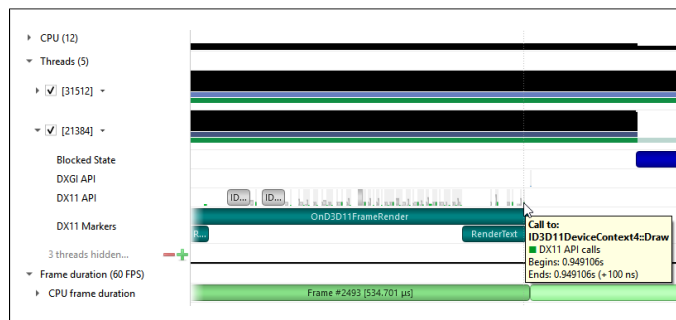
Chapter 7.

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.



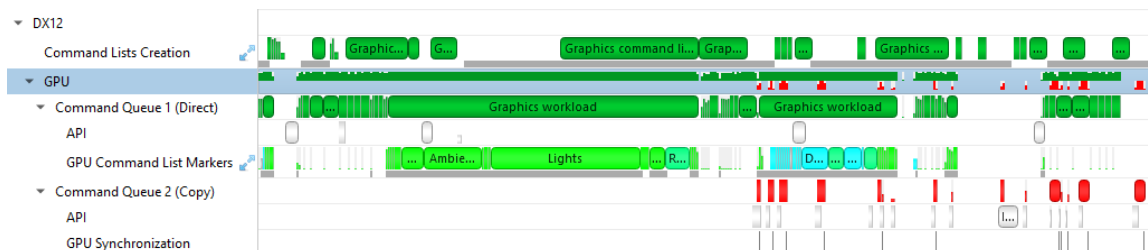
SLI Trace

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`.

Command Lists Creation



The GPU row shows an aggregated view of D3D12 API calls and GPU workloads. Note that not all D3D12 API calls are logged.



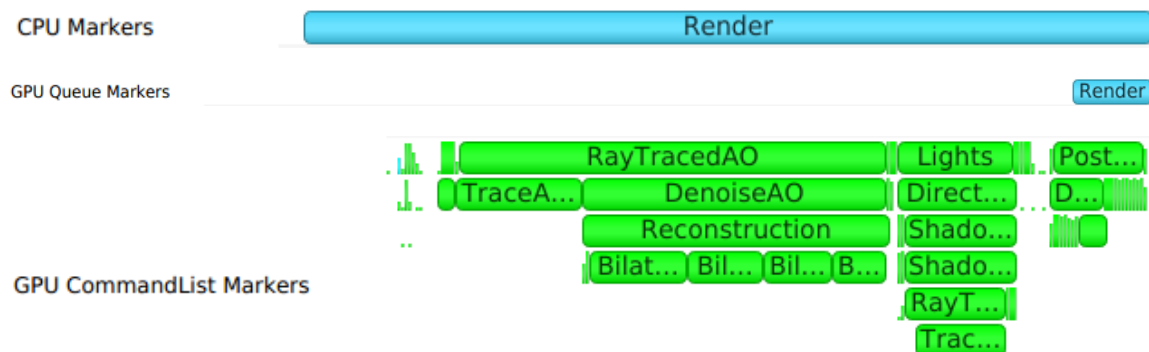
A Command Queue row is displayed for each D3D12 command queue created by the profiled application. The row's header displays the queue's running index and its type (Direct, Compute, Copy).

- ▶ Command Queue 0 (Compute)
- ▶ Command Queue 1 (Direct)

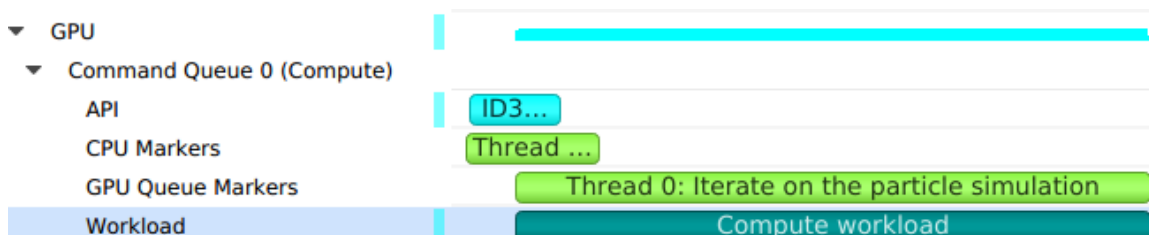
The API row displays time periods where `ID3D12CommandQueue::ExecuteCommandLists` was called. The GPU Workload row displays time periods where workloads were executed by the GPU. The workload's type (Graphics, Compute, Copy, etc.) is displayed on the bar representing the workload's GPU execution.



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.



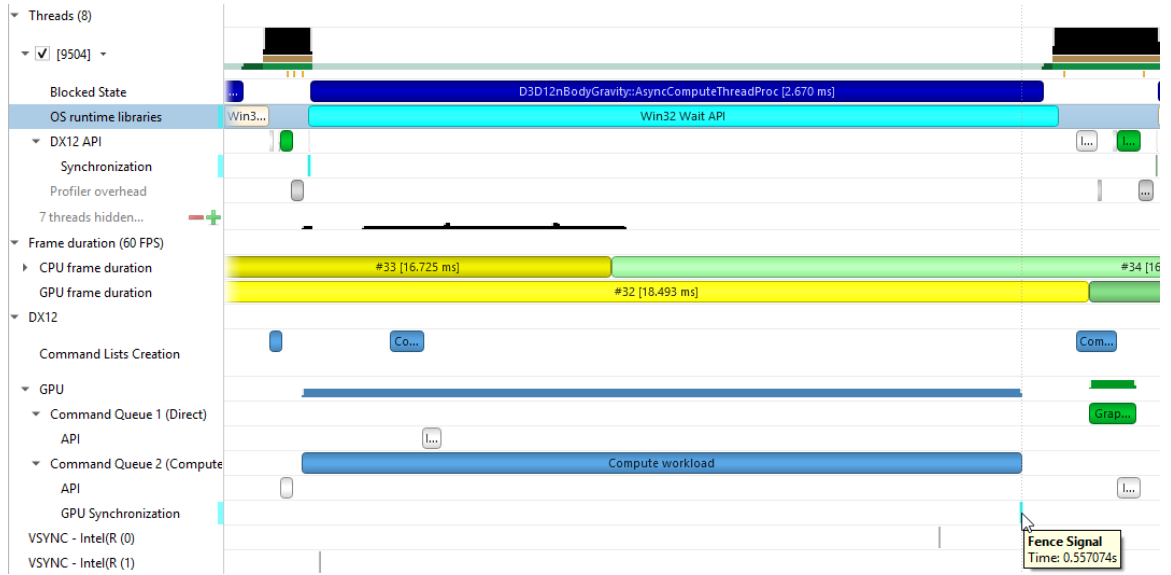
Clicking on a GPU workload highlights the corresponding `ID3D12CommandQueue::ExecuteCommandLists`, `ID3D12GraphicsCommandList::Reset` and `ID3D12GraphicsCommandList::Close` API calls, and vice versa.



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.



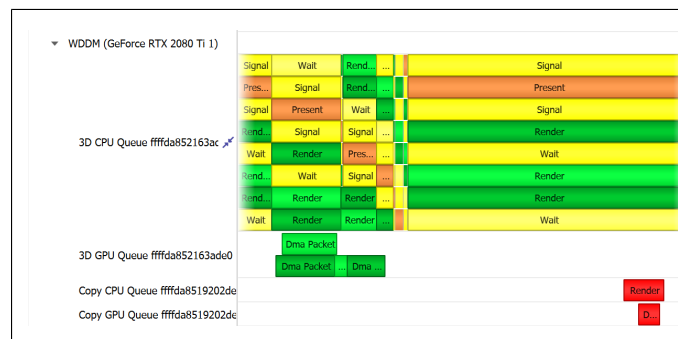
Chapter 8.

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 DxxKrnL events 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.

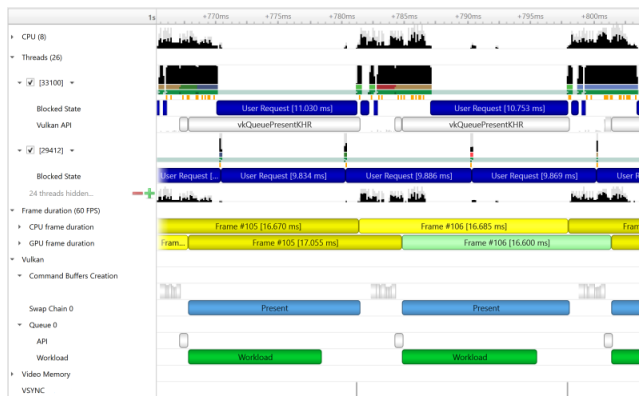
To retain the .etl trace files captured, so that they can be viewed in other tools (e.g. GPUView), change the "Save ETW log files in project folder" option under "Profile Behavior" in Nsight Systems's global Options dialog. The .etl files will appear in the same folder as the .nsys-rep file, accessible 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. VULKAN API TRACE

9.1. 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`.



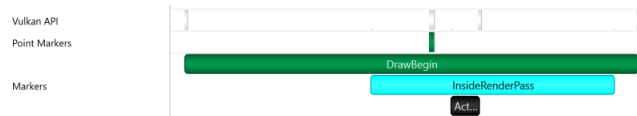
The Swap chains row displays the available swap chains and the time periods where `vkQueuePresentKHR` was executed on each swap chain.



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.

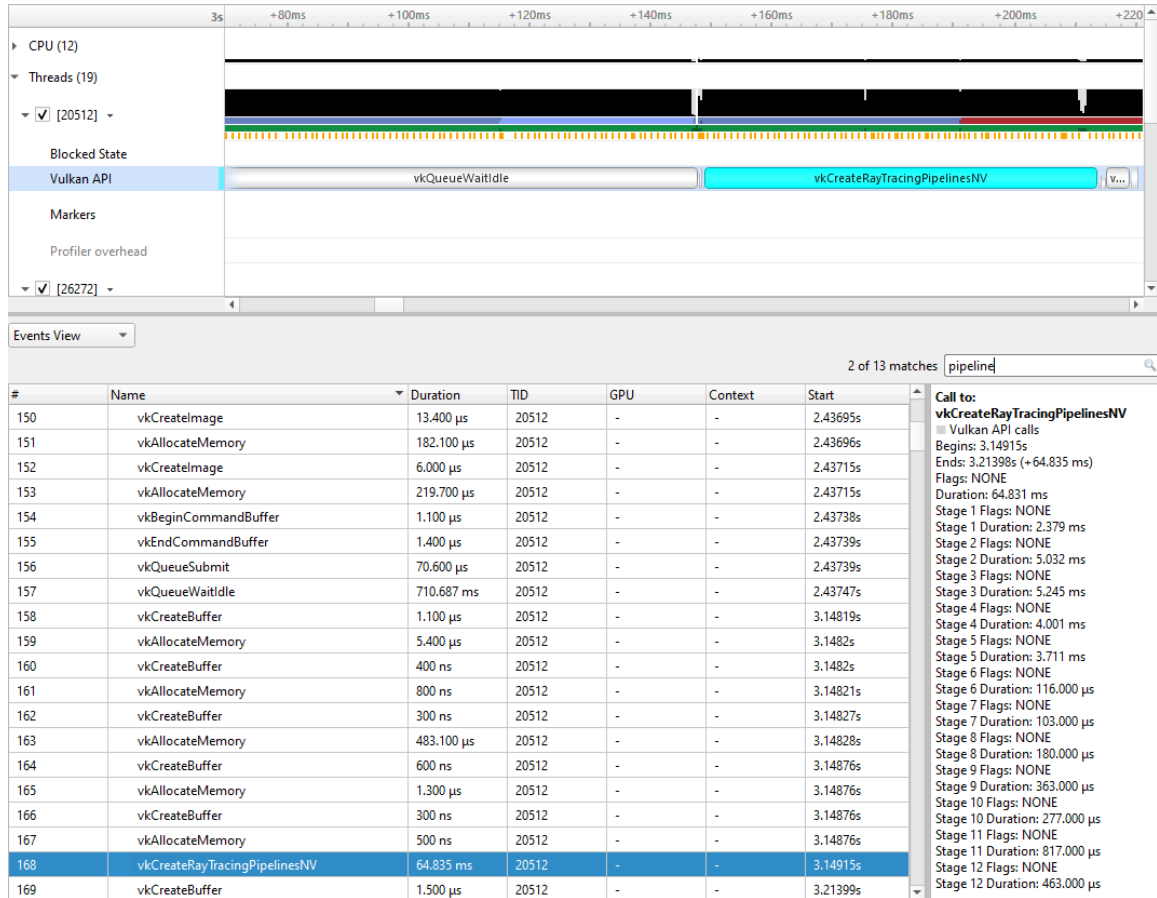


9.2. Pipeline Creation Feedback

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.



9.3. 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 10.

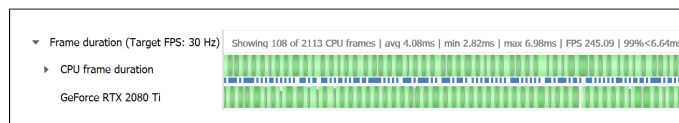
STUTTER ANALYSIS

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.

10.1. FPS Overview

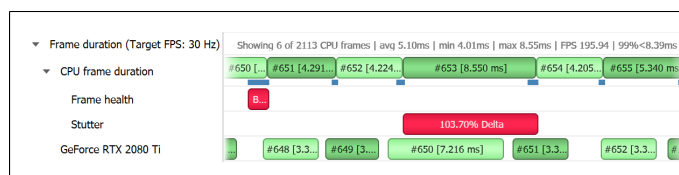
The Frame Duration section displays frame durations on both the CPU and the GPU.



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)

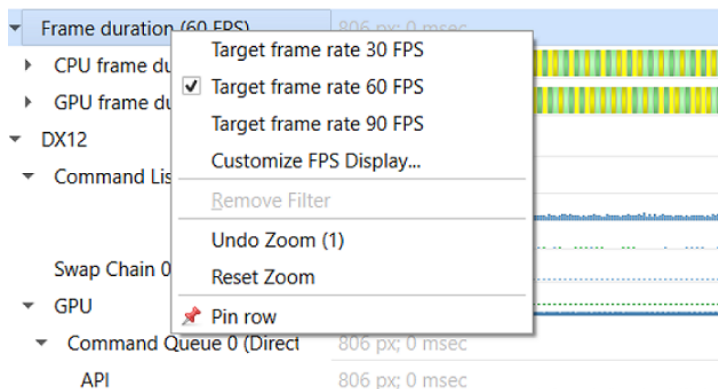
OSC detection

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.

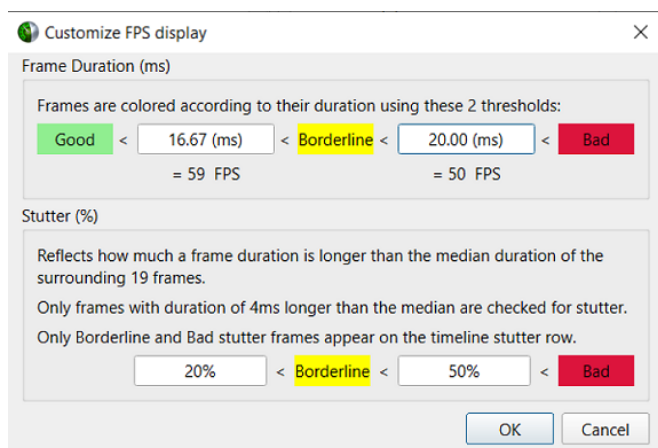
To address the issue and identify if oscillating frames, the following method is applied:

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 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

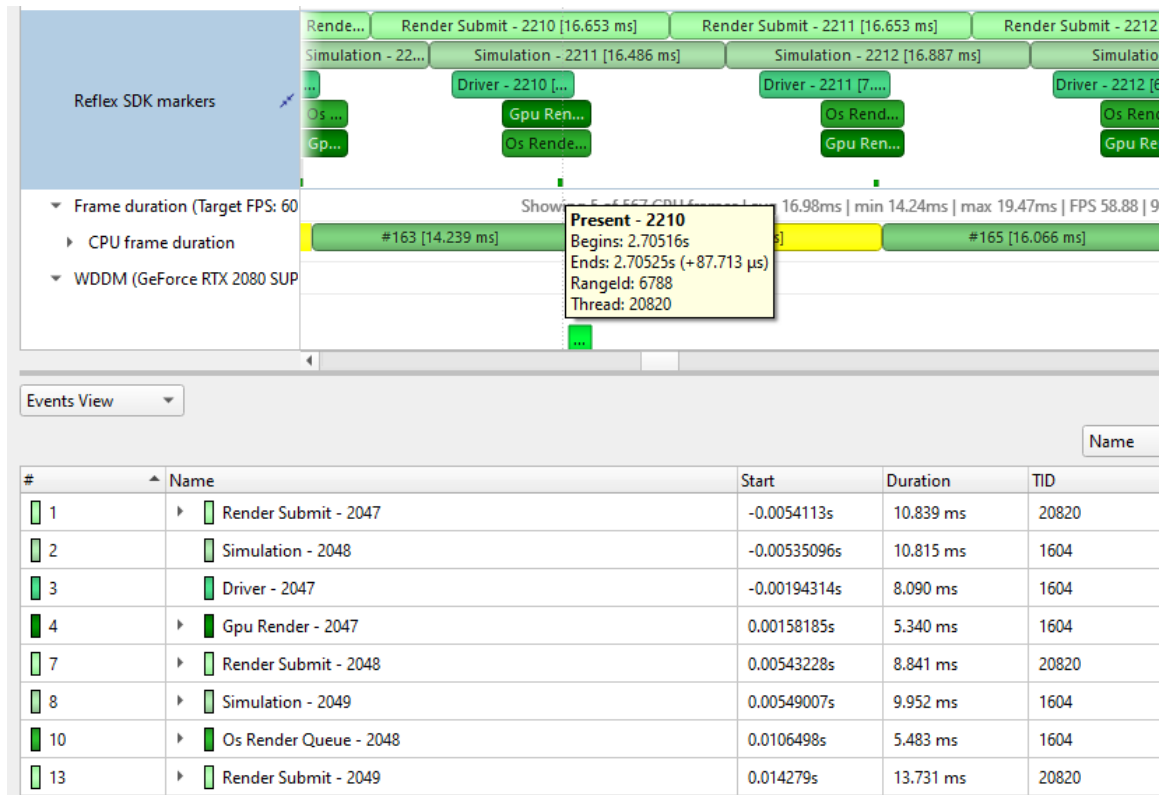
NVIDIA Reflex SDK is a series of NVAPI calls that allow applications to integrate the Ultra Low Latency driver feature more directly into their game to further optimize synchronization between simulation and rendering stages and lower the latency between user input and final image rendering. For more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

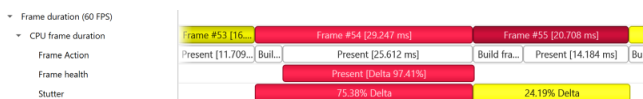
► GPU Render.



10.2. 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:





10.3. GPU Memory Utilization

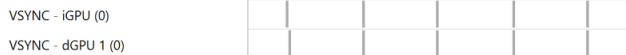
The Memory Utilization row displays the amount of used local GPU memory and the commit limit for each GPU.



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

10.4. Vertical Synchronization

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

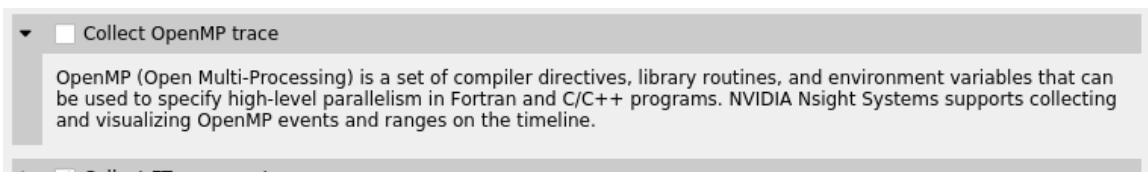


Chapter 11.

OPENMP TRACE

Nsight Systems for Linux x86_64 and Power targets 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

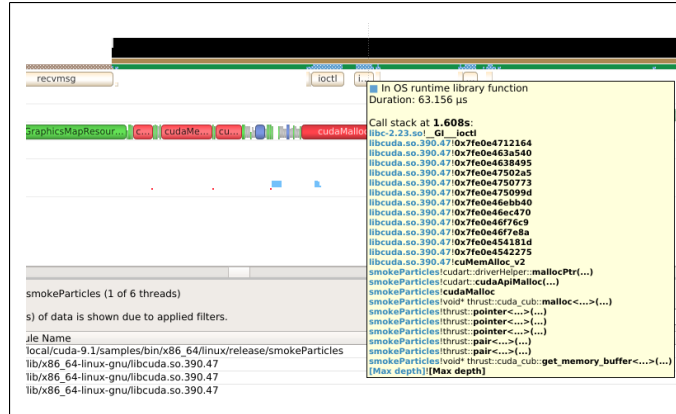
Chapter 12.

OS RUNTIME LIBRARIES TRACE

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 tracing complements and enhances sampling information by:

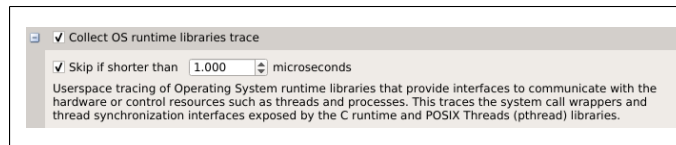
1. Visualizing when the process is communicating with the hardware, controlling resources, performing multi-threading synchronization or interacting with the kernel scheduler.
2. Adding additional thread states by correlating how OS runtime libraries traces affect the thread scheduling:
 - ▶ **Waiting** — 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.

12.1. 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.

12.2. 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 μ s 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.

12.3. 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.

12.4. 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
fgetc
fgetc_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_spawn
sigwait
sigwaitinfo
sleep
system
usleep

```

Chapter 13.

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.
5. If you are on Android target, make sure that your application is launched by Nsight Systems. This is required so that the necessary launch environment is prepared, and the library responsible for collection of NVTX trace data is properly injected into the process.
6. If you are on Linux on Tegra, if launching the application manually, the following environment variables should be specified:

- ▶ For ARMv7 processes:

```
NVTX_INJECTION32_PATH=/opt/nvidia/nsight_systems/libToolsInjection32.so
```

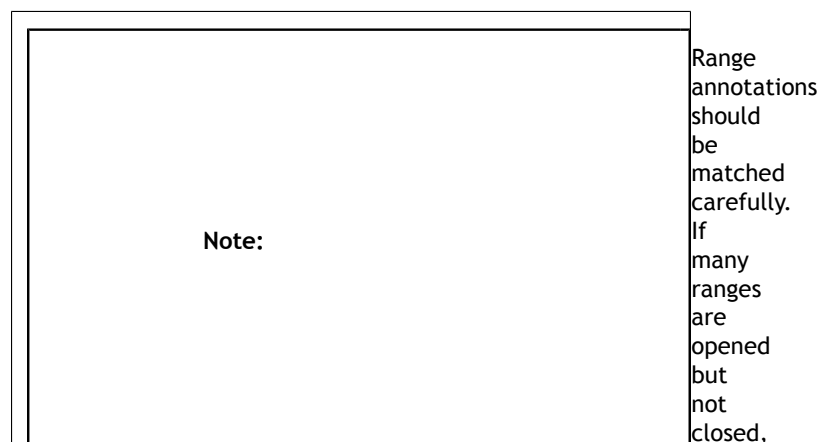
- ▶ For ARMv8 processes:

```
NVTX_INJECTION64_PATH=/opt/nvidia/nsight_systems/libToolsInjection64.so
```

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.



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.

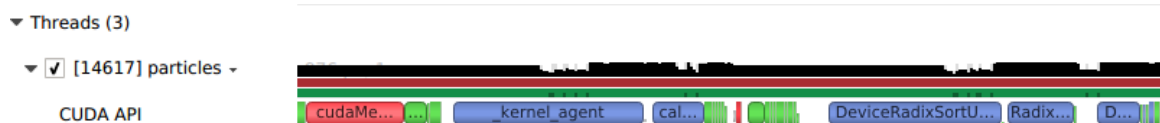
Chapter 14.

CUDA TRACE

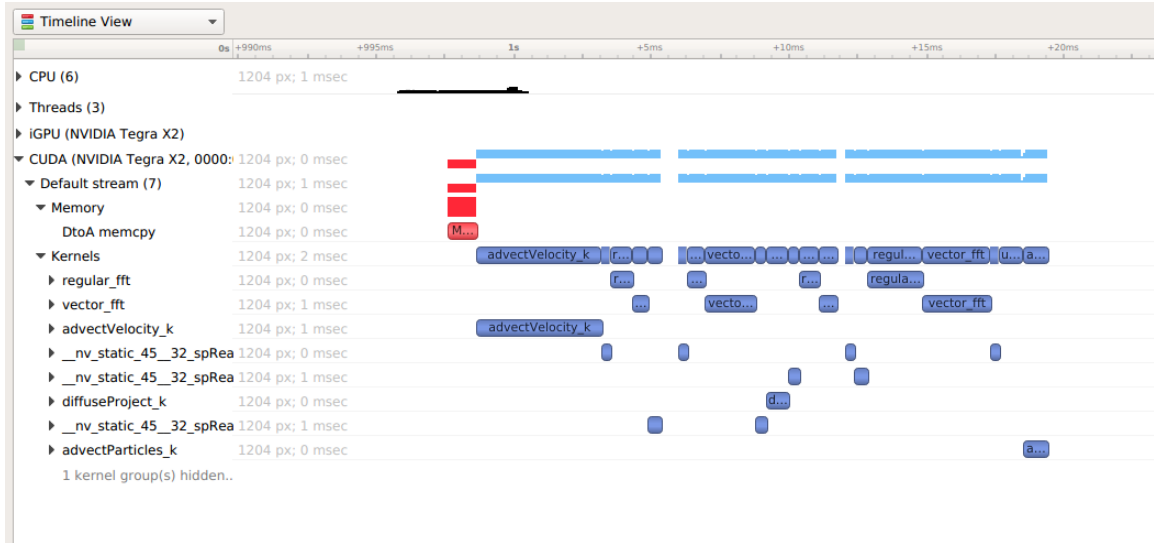
Nsight Systems is capable of capturing information about CUDA execution in the profiled process.

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.

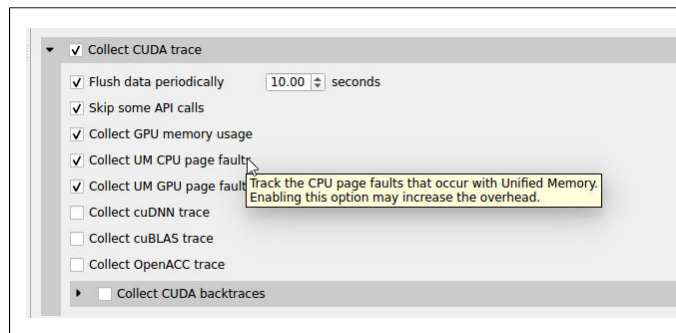


Near the bottom of the timeline row tree, the GPU node will appear and contain a CUDA node. Within the CUDA node, each CUDA context used within the process will be shown along with its corresponding CUDA streams. Streams will contain memory operations and kernel launches on the GPU. Kernel launches are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

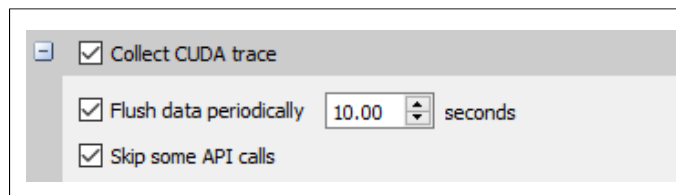


The easiest way to capture CUDA information is to launch the process from Nsight Systems, and it will setup the environment for you. To do so, simply set up a normal launch and select the **Collect CUDA trace** checkbox.

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.
- ▶ 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.

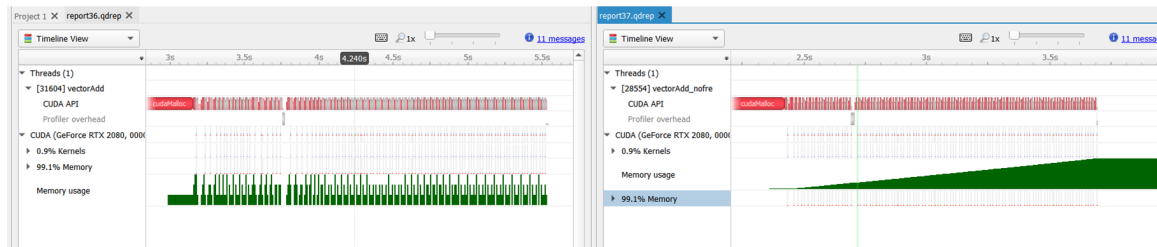
- ▶ For Nsight Systems Embedded Platforms Edition if desired, the target application can be manually set up to collect CUDA trace. To capture information about CUDA execution, the following requirements should be satisfied:
 - ▶ The profiled process should be started with the specified environment variable, depending on the architecture of the process:
 - ▶ For ARMv7 (32-bit) processes: `CUDA_INJECTION32_PATH`, which should point to the injection library:
`/opt/nvidia/nsight_systems/libToolsInjection32.so`
 - ▶ For ARMv8 (64-bit) processes: `CUDA_INJECTION64_PATH`, which should point to the injection library:
`/opt/nvidia/nsight_systems/libToolsInjection64.so`
 - ▶ If the application is started by Nsight Systems, all required environment variables will be set automatically.

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.

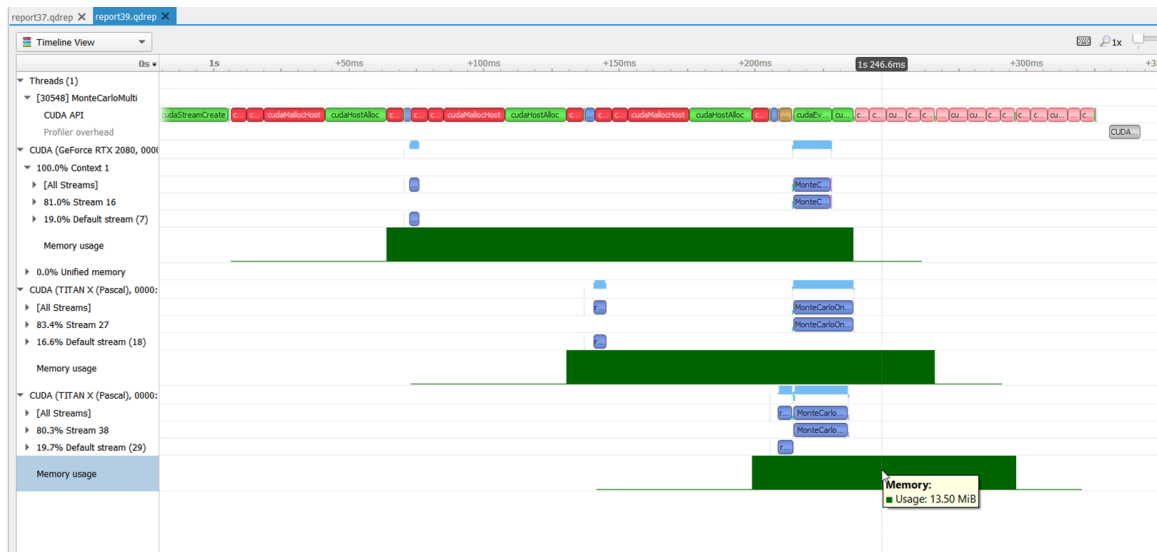
14.1. CUDA GPU Memory Allocation Graph

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



14.2. 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:

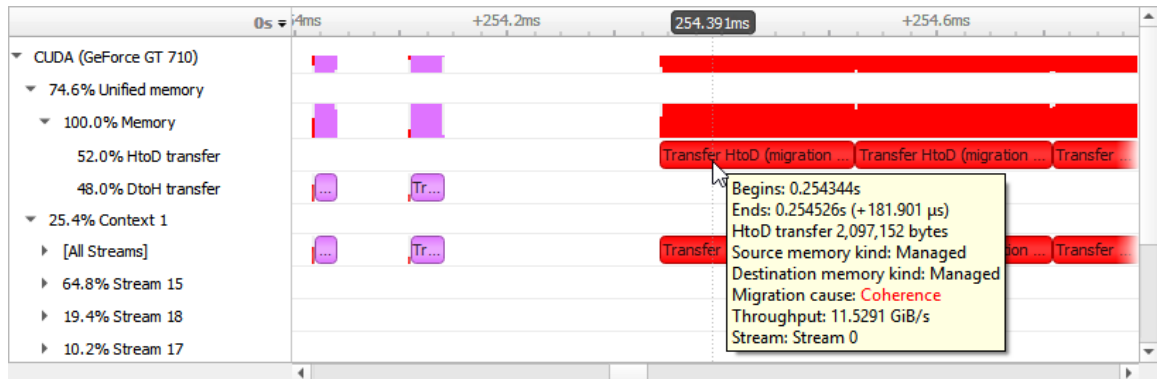


HtoD transfer indicates the CUDA kernel accessed managed memory that was residing on the host, so the kernel execution paused and transferred the data to the device. Heavy traffic here will incur performance penalties in CUDA kernels, so consider using manual `cudaMemcpy` operations from pinned host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

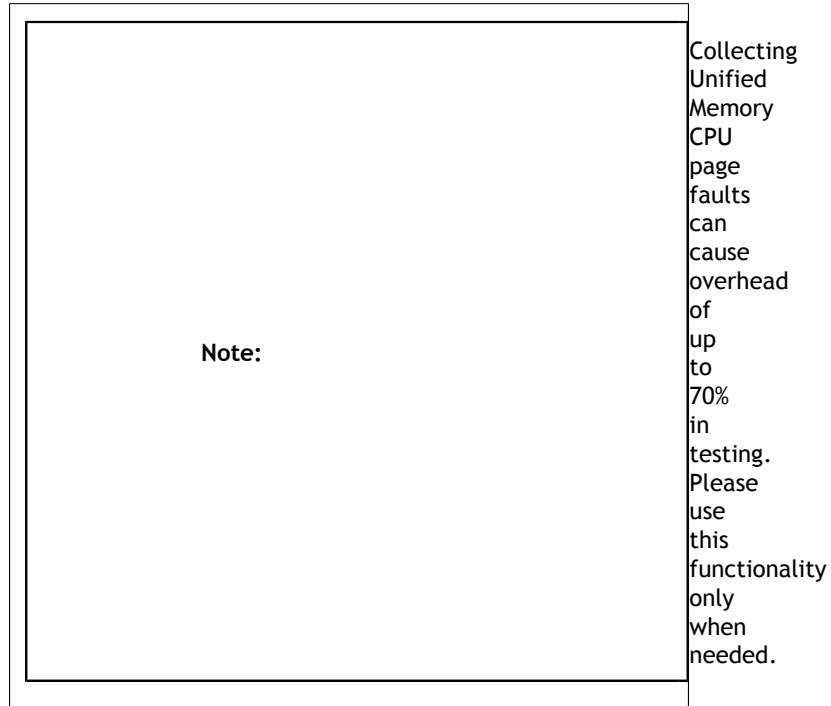


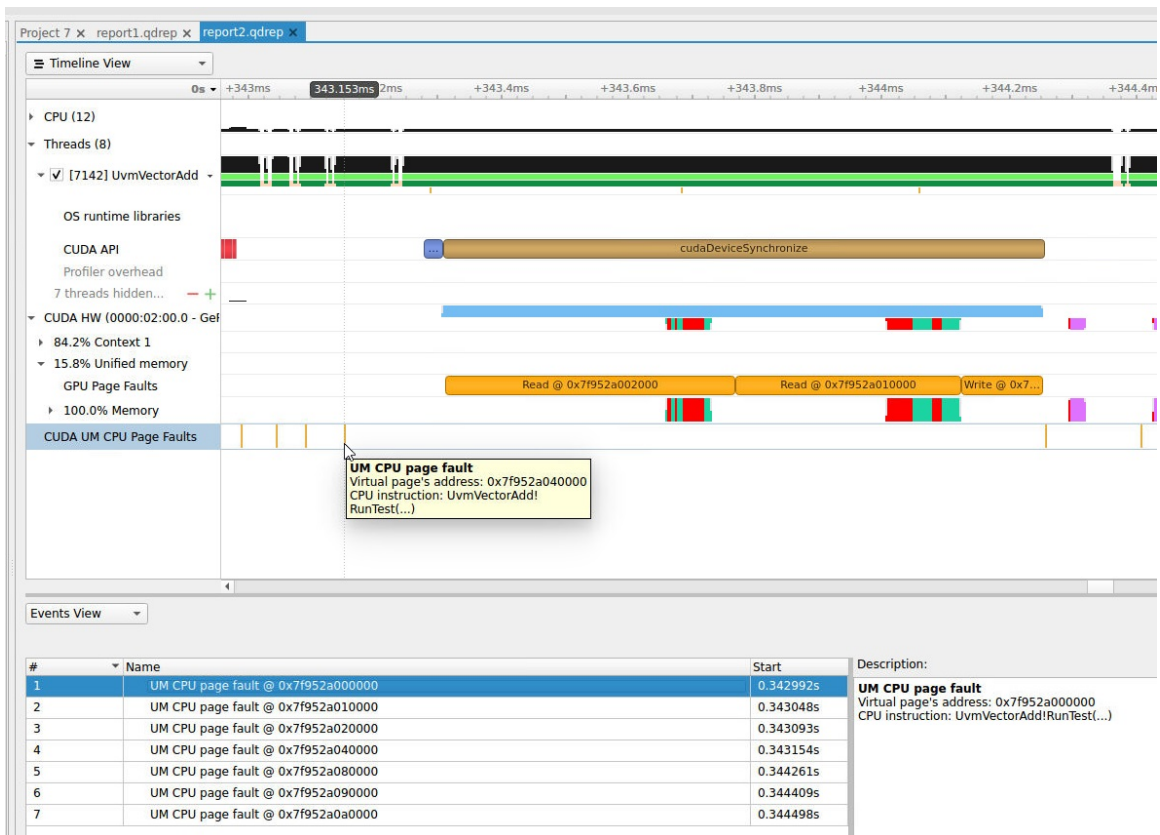
Transfers with the following migration causes are highlighted:

- ▶ **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

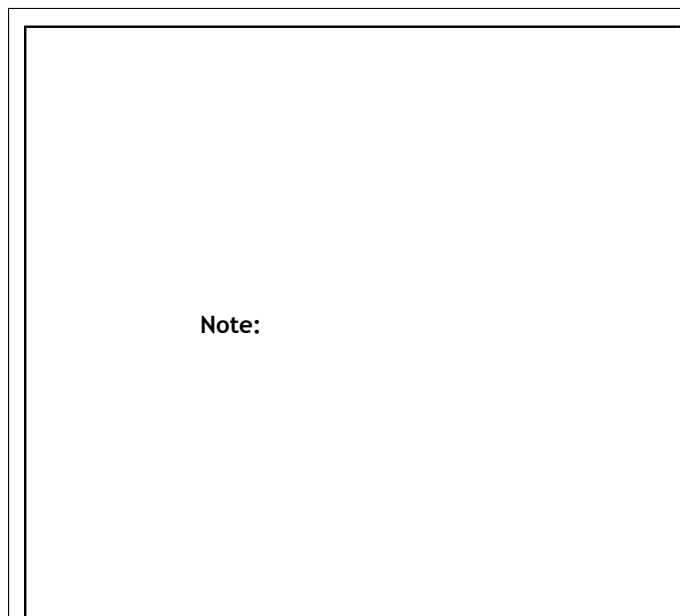
The Unified Memory CPU page faults feature in Nsight Systems tracks the page faults that occur when CPU code tries to access a memory page that resides on the device.





Unified Memory GPU Page Faults

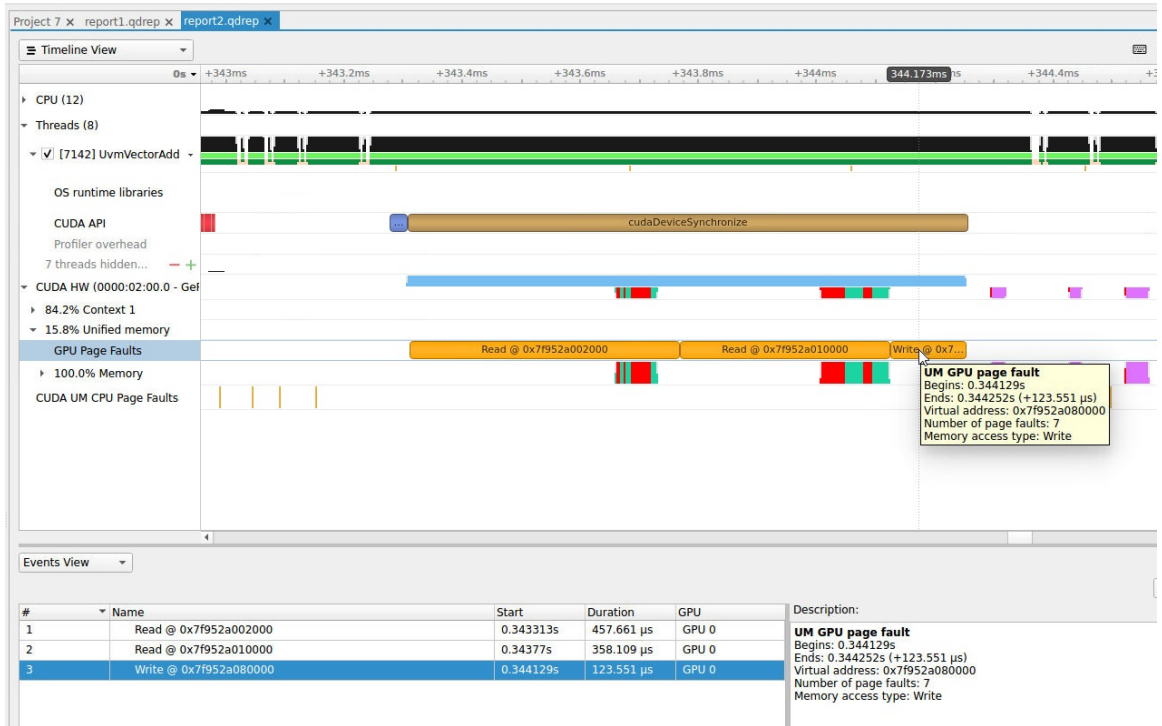
The Unified Memory GPU page faults feature in Nsight Systems tracks the page faults that occur when GPU code tries to access a memory page that resides on the host.



Note:

Collecting Unified Memory GPU page faults can cause overhead of up to 70% in testing. Please use this functionality only

when needed.



14.3. 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
```

14.4. cuDNN Function List for X86 CLI

cuDNN API functions

```

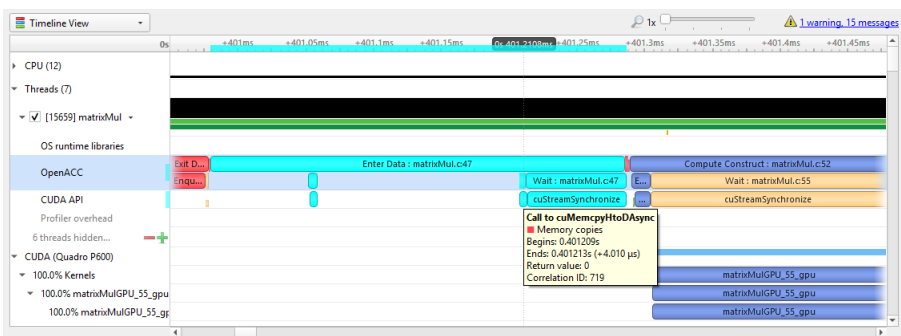
cudnnActivationBackward
cudnnActivationBackward_v3
cudnnActivationBackward_v4
cudnnActivationForward
cudnnActivationForward_v3
cudnnActivationForward_v4
cudnnAddTensor
cudnnBatchNormalizationBackward
cudnnBatchNormalizationBackwardEx
cudnnBatchNormalizationForwardInference
cudnnBatchNormalizationForwardTraining
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 15. OPENACC TRACE

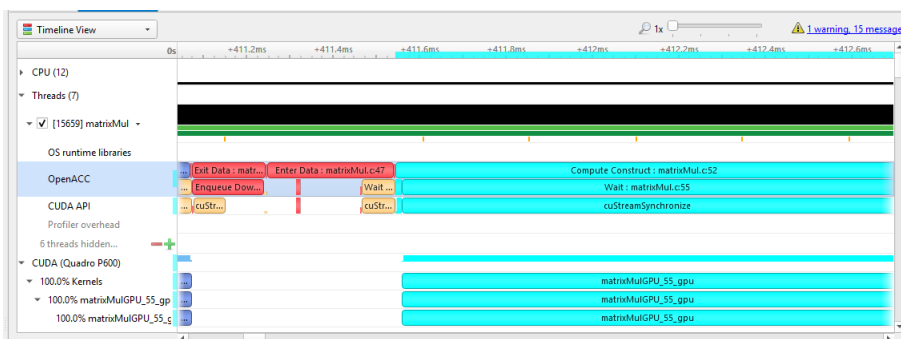
Nsight Systems for Linux x86_64 and Power targets is capable of capturing information about OpenACC execution in the profiled process.

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.

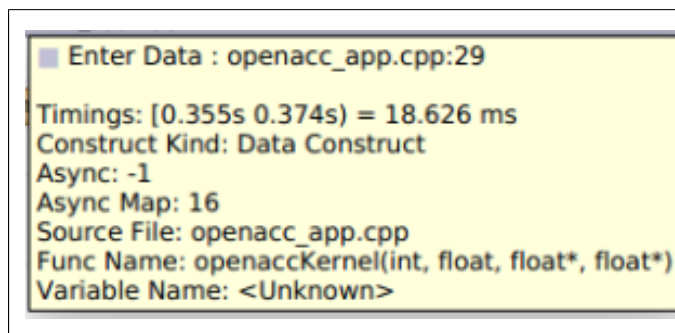
Under the CPU rows in the timeline tree, each thread that uses OpenACC will show OpenACC trace information. You can click on a OpenACC API call to see correlation with the underlying CUDA API calls (highlighted in teal):



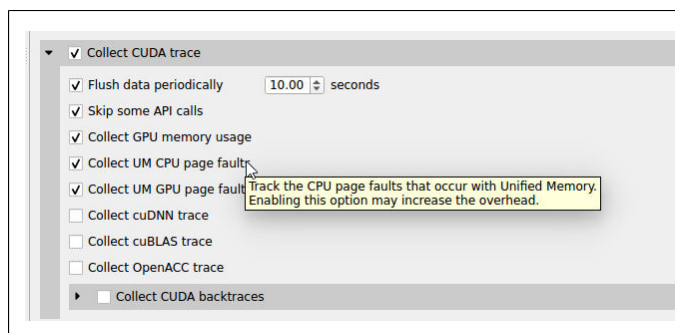
If the OpenACC API results in GPU work, that will also be highlighted:



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 16.

OPENGL TRACE

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

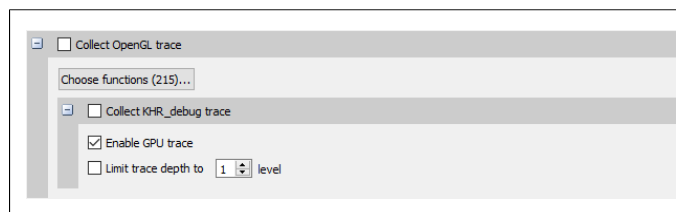
A few usage examples are:

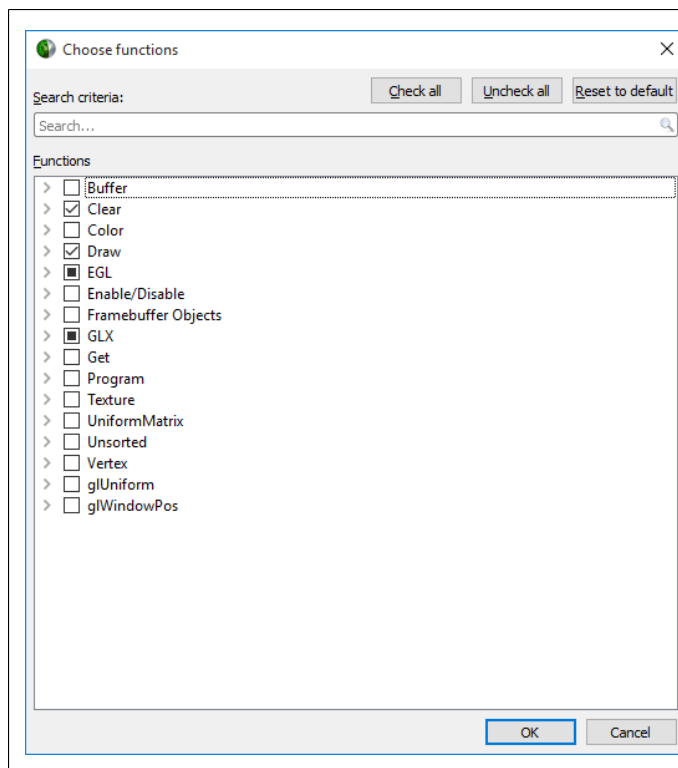
1. Visualize how long **eglSwapBuffers** (or similar) is taking.
2. API trace can easily show correlations between thread state and graphics driver's behavior, uncovering where the CPU may be waiting on the GPU.
3. Spot bubbles of opportunity on the GPU, where more GPU workload could be created.
4. Use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

16.1. 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
glClearNamedFramebufferiv
glClearNamedFramebufferiv
glClearNamedFramebufferfv
glClearNamedFramebufferfi
glClearNamedBufferSubDataEXT
glClearNamedBufferSubData
glClearNamedBufferDataEXT
glClearNamedBufferData
glClearIndex
glClearDepthx
glClearDepthf
glClearDepthdNV
glClearDepth
glClearColorx
glClearColorIuiEXT
glClearColorIiEXT
glClearColor
glClearBufferiv
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 17.

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.

Add provider

Please enter the provider information:

Name:

Guid:

Optional:

Buffer Size (KB):

Min Buffers:

Max Buffers:

Keyword:

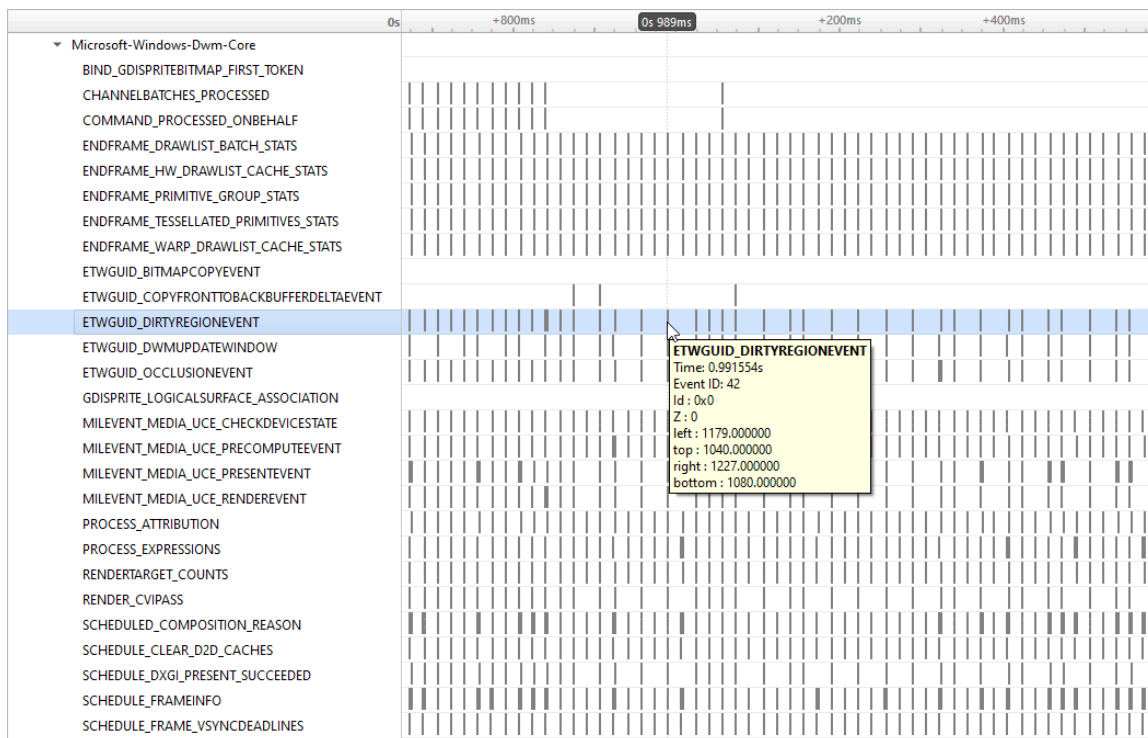
Level:

Flags:

Custom ETW Trace

Details of ETW providers included in the trace

Name	GUID	Flags	Buffer Size (KB)	Min Buffers	Max Buffers	TRAC
Microsoft-Windows-Dwm-Core	9E9BBA3C-2E38-40CB-99F4-9E8281425164	0x0	0	0	0	TRAC



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 18.

GPU METRIC SAMPLING

Overview

GPU performance metrics sampling 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.



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

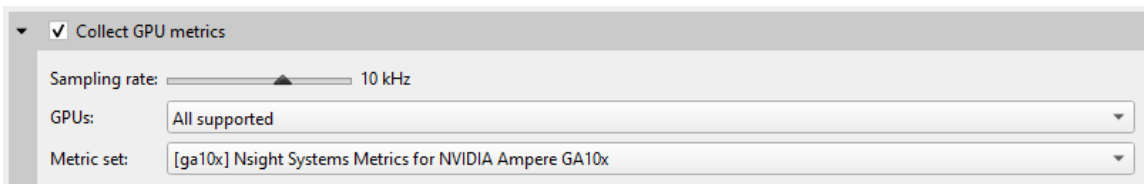
Nsight Systems GPU metric sampling is only available for Linux targets on x86-64 and for Windows targets. It requires NVIDIA Turing architecture or newer with minimum driver version r460.

Note: 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.

Launching GPU Metric Sampling from the GUI

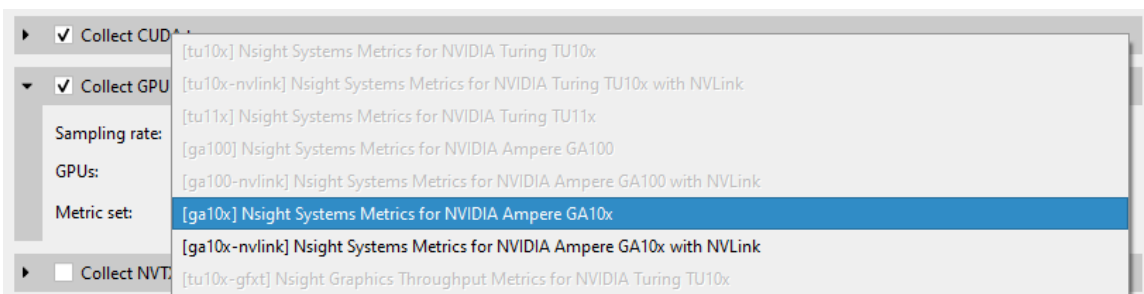
For commands to launch GPU metric sampling from the CLI with examples, see the [CLI documentation](#).

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.

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 GPU metrics 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 GPU metrics sampling rate is based upon a fixed frequency clock. The maximum sampling rate 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 warp 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 the 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 the contents of the 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 metrics 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 metric sampling 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 sampling data. Analysis with higher sampling rates or on GPUs with more SMs has a risk of filling these buffers. This will lead to gaps with long samples on timeline. If you select that area on the timeline you will see that the counters will pause and remain at a steady state for a while. Future releases will reduce the frequency of this happening and better present these periods.

19.1. 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
nvEncGetSequenceParams
nvEncRegisterAsyncEvent
nvEncUnregisterAsyncEvent
nvEncMapInputResource
nvEncUnmapInputResource
nvEncDestroyEncoder
nvEncInvalidateRefFrames
nvEncOpenEncodeSessionEx
nvEncRegisterResource
nvEncUnregisterResource
nvEncReconfigureEncoder
nvEncCreateMVBuffer
nvEncDestroyMVBuffer
nvEncRunMotionEstimationOnly
nvEncGetLastErrorString
nvEncSetIOCUDAStreams
nvEncGetSequenceParamEx
```

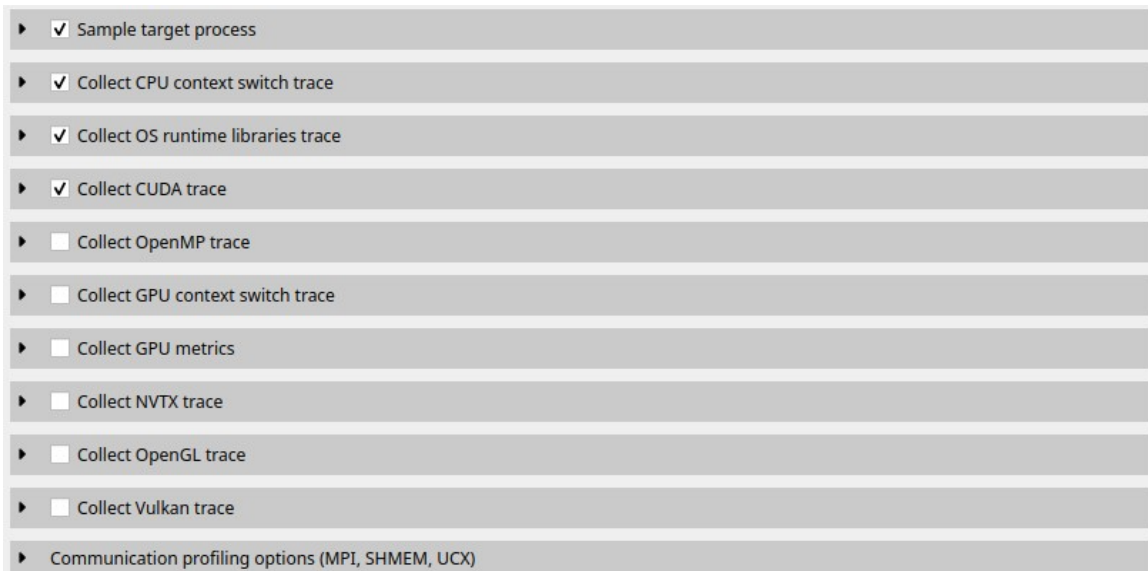
19.2. NV Decoder API Functions Traced by Default

```
cuvidCreateVideoSource
cuvidCreateVideoSourceW
cuvidDestroyVideoSource
cuvidSetVideoSourceState
cudaVideoState
cuvidGetSourceVideoFormat
cuvidGetSourceAudioFormat
cuvidCreateVideoParser
cuvidParseVideoData
cuvidDestroyVideoParser
cuvidCreateDecoder
cuvidDestroyDecoder
cuvidDecodePicture
cuvidGetDecodeStatus
cuvidReconfigureDecoder
cuvidMapVideoFrame
cuvidUnmapVideoFrame
cuvidMapVideoFrame64
cuvidUnmapVideoFrame64
cuvidCtxLockCreate
cuvidCtxLockDestroy
cuvidCtxLock
cuvidCtxUnlock
```


Chapter 20.

NETWORK COMMUNICATION PROFILING

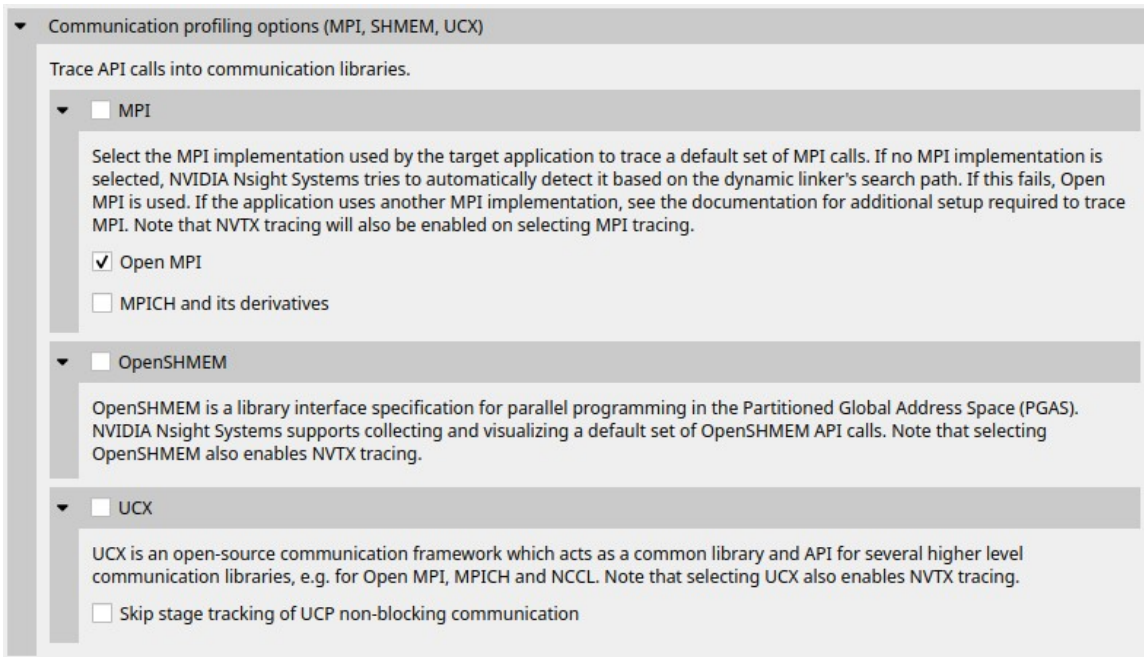
Nsight Systems can be used to profiles several popular network communication protocols. To enable this, please select the **Communication profiling options** dropdown.



The image shows a dropdown menu with the following options:

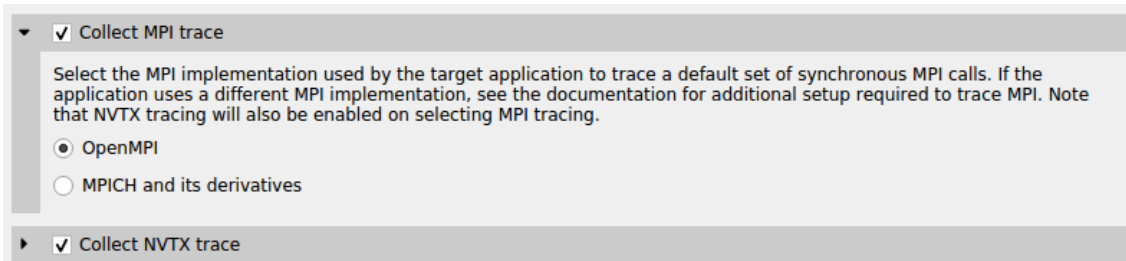
- Sample target process
- Collect CPU context switch trace
- Collect OS runtime libraries trace
- Collect CUDA trace
- Collect OpenMP trace
- Collect GPU context switch trace
- Collect GPU metrics
- Collect NVTX trace
- Collect OpenGL trace
- Collect Vulkan trace
- Communication profiling options (MPI, SHMEM, UCX)

Then select the libraries you would like to trace:

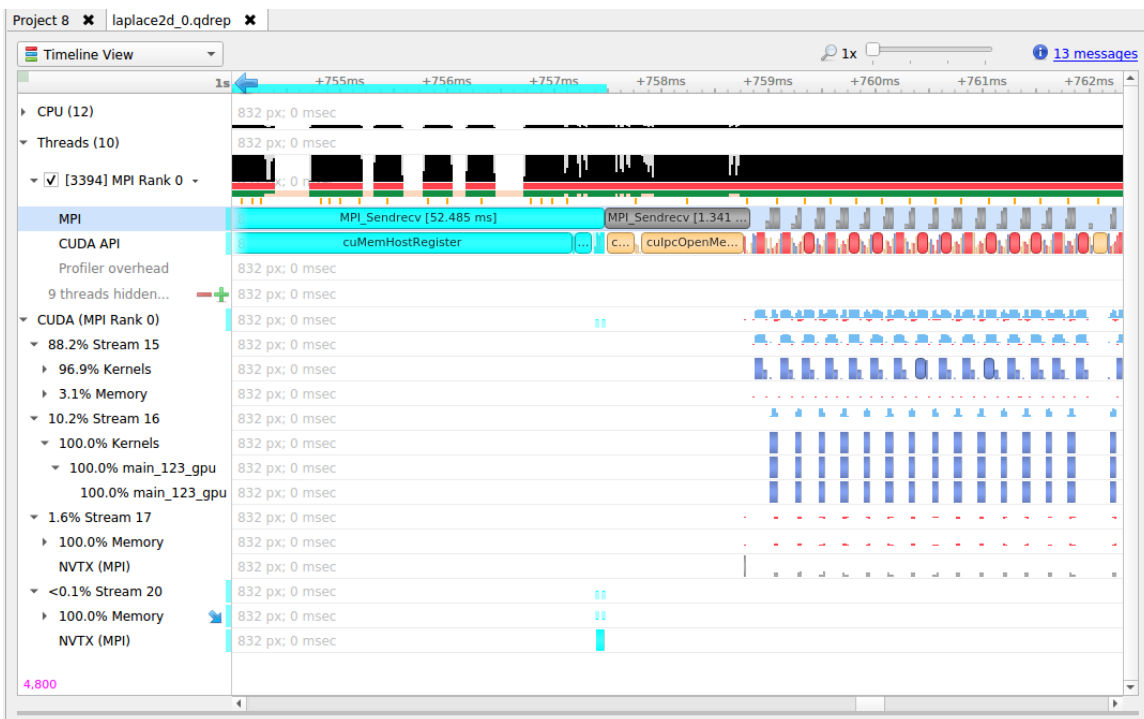


20.1. MPI API Trace

For Linux x86_64 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 only for the OpenMPI and MPICH implementations of MPI and only for a default list of synchronous APIs.



If you require more control over the list of traced APIs or if you are using a different MPI implementation, see [github nvtx pmpi wrappers](#). You can use this documentation to generate a shared object to wrap a list of synchronous MPI APIs with NVTX using the MPI profiling interface (PMPI). If you set your LD_PRELOAD environment variable to the path of that object, Nsight Systems will capture and report the MPI API trace information when NVTX tracing is enabled.



NVTX tracing is automatically enabled when MPI trace is turned on.

20.2. 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*
```

20.3. 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,check_status,is_completed}
ucp_rkey_{buffer_release,destroy,pack,ptr}
ucp_stream_data_release
ucp_stream_recv_{data_nb,request_test}
ucp_stream_{send,recv}_nb[x]
ucp_stream_worker_poll
ucp_tag_msg_recv_nb[x]
ucp_tag_probe_nb
ucp_tag_{send,recv}_nbr
ucp_tag_{send,recv}_nb[x]
ucp_tag_recv_request_test
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,rkey_unpack}
ucp_mem_print_info
ucp_request_{test,free,release}
ucp_worker_{progress,query,release_address,print_info}
```

Additional API functions from other UCX layers may be added in a future version of the product.

20.4. 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**.

Chapter 21.

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]	0xffffffffc000080000- 0xffffffffc001471010	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%

Chapter 22.

READING YOUR REPORT IN GUI

22.1. 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 (`.qdpproj`).

22.2. Opening an Existing Report

An existing `.nsys-rep` file can be opened using **File > Open...**

22.3. 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.

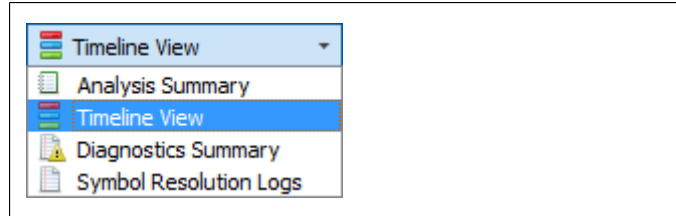
Project files (`.qdpproj`) are currently not shareable, since they contain full paths to the report files.

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.

22.4. 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.

22.5. 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.

22.6. 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.



22.6.1. 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 shown on the timeline.

To generate a timeline screenshot without opening the full GUI, use the command

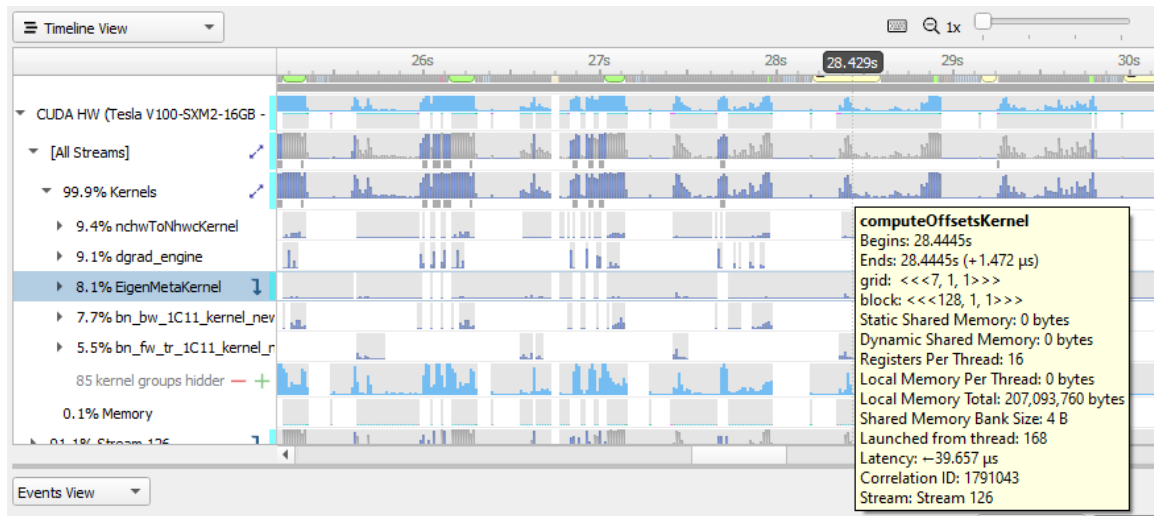
```
nsys-ui.exe --screenshot filename.nsys-rep
```

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.

22.6.2. 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

#	Name	Duration	TID	GPU	Context	Start
39	ID3D12GraphicsCommandList::Reset	13.300 µs	2092	-	-	0.0016661s
40	Scene Render	352.100 µs	2092	-	-	0.0017093s
41	RenderLightShadows	1.900 µs	2092	-	-	0.0017207s
43	Z PrePass	80.300 µs	2092	-	-	0.0017286s
49	Generate SSAO	121.700 µs	2092	-	-	0.0018155s
57	Render Shadow Map	39.100 µs	2092	-	-	0.0019445s
59	Raytrace	68.600 µs	2092	-	-	0.0019903s
64	Marker End	-	2092	-	-	0.0020614s
65	ID3D12GraphicsCommandList::Close	12.400 µs	2092	-	-	0.0020753s
66	ID3D12CommandQueue::ExecuteCommandLists	69.800 µs	2092	-	-	0.0020892s
67	ntdll.dll!0x7ff9a47ff3b4	-	2092	-	-	0.0021694s
68	ID3D12GraphicsCommandList::Reset	10.300 µs	2092	-	-	0.0021988s
69	Post Effects	61.300 µs	2092	-	-	0.0022258s
75	ID3D12GraphicsCommandList::Close	7.100 µs	2092	-	-	0.0022964s
76	ID3D12CommandQueue::ExecuteCommandLists	33.300 µs	2092	-	-	0.0023048s
77	ntdll.dll!0x7ff9a47ff3b4	-	2092	-	-	0.0023465s

Call to: ID3D12CommandQueue::ExecuteCommandLists

■ DX12 API calls

Begins: 0.0020892s

Ends: 0.002159s (+69.800 µs)

Correlation IDs: {30507, 30507}

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.

Events View

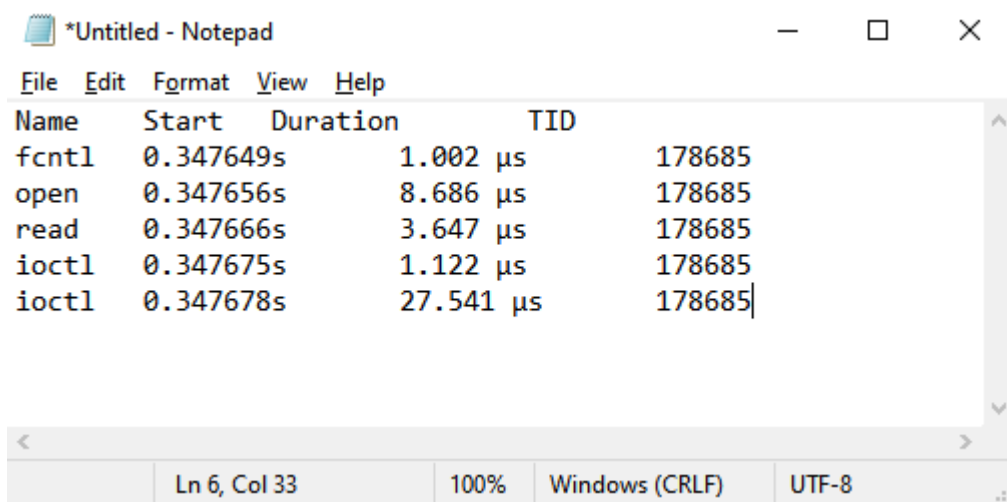
#	Name	Start	Duration	TID
4	fopen	0.347611s	5.921 µs	178685
5	fclose	0.347628s	1.724 µs	178685
6	open64	0.347636s	11.501 µs	178685
7	fcntl	0.347649s	1.002 µs	178685
8	ioctl	0.347652s	3.176 µs	178685
9	open	0.347656s	8.686 µs	178685
10	read	0.347666s	3.647 µs	178685
11	ioctl	0.347675s	1.122 µs	178685
12	ioctl	0.347678s	27.541 µs	178685
13	ioctl	0.347707s	6.141 µs	178685
14	ioctl	0.347713s	16.040 µs	178685

Highlight Selected on Timeline

Show Current on Timeline

Copy Selected

Pasting into text gives you a tab separated view:

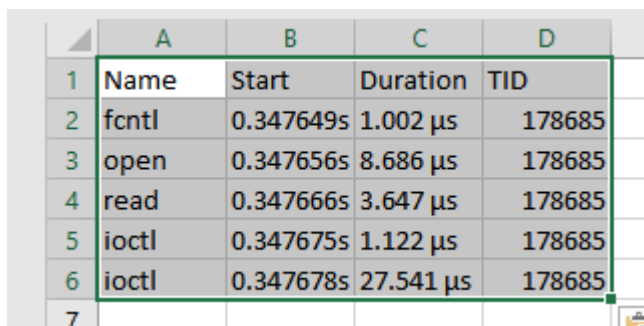


```

*Untitled - Notepad
File Edit Format View Help
Name      Start      Duration      TID
fcntl    0.347649s    1.002 µs     178685
open     0.347656s    8.686 µs     178685
read     0.347666s    3.647 µs     178685
ioctl    0.347675s    1.122 µs     178685
ioctl    0.347678s    27.541 µs    178685

```

Pasting into spreadsheet properly copies into rows and columns:



	A	B	C	D
1	Name	Start	Duration	TID
2	fcntl	0.347649s	1.002 µs	178685
3	open	0.347656s	8.686 µs	178685
4	read	0.347666s	3.647 µs	178685
5	ioctl	0.347675s	1.122 µs	178685
6	ioctl	0.347678s	27.541 µs	178685
7				

22.6.3. Function Table Modes



The function table can work in three modes:

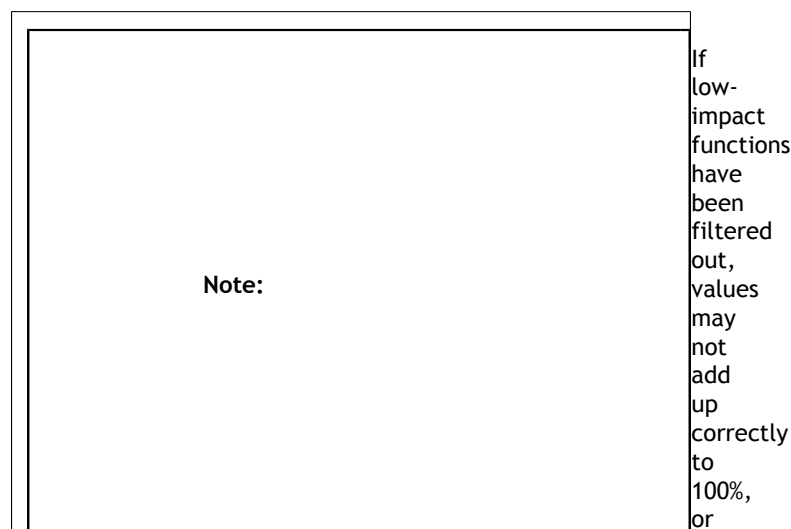
- ▶ **Top-Down View** — In this mode, expanding top-level functions provides information about the *callee* functions. One of the top-level functions is typically the main function of your application, or another entry point defined by the runtime libraries.
- ▶ **Bottom-Up View** — This is a reverse 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.

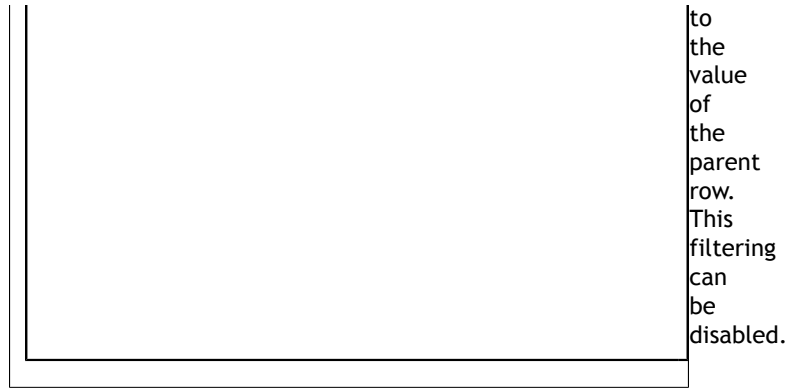
Each of the views helps understand particular performance issues of the application being profiled. For example:

- ▶ 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.





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:

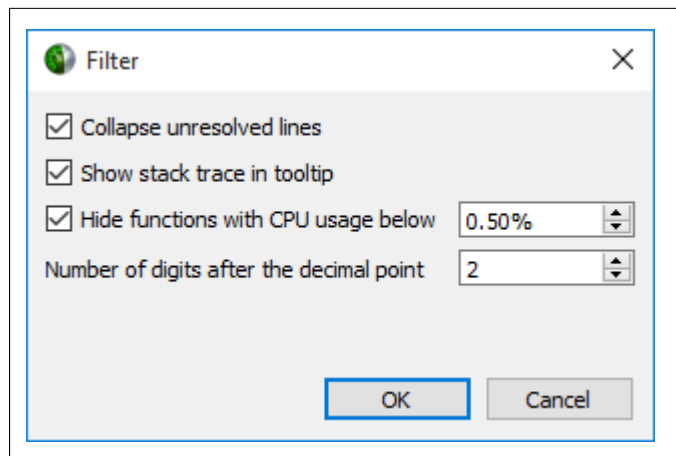
- ▶ **Per-thread filtering** — Each thread that has sampling information associated with it has a checkbox next to it on the timeline. Only threads with selected checkboxes are represented in the symbols table.
- ▶ **Time filtering** — A time filter can be setup on the timeline by pressing the left mouse 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



22.6.4. 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.

22.7. 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.

22.8. 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.

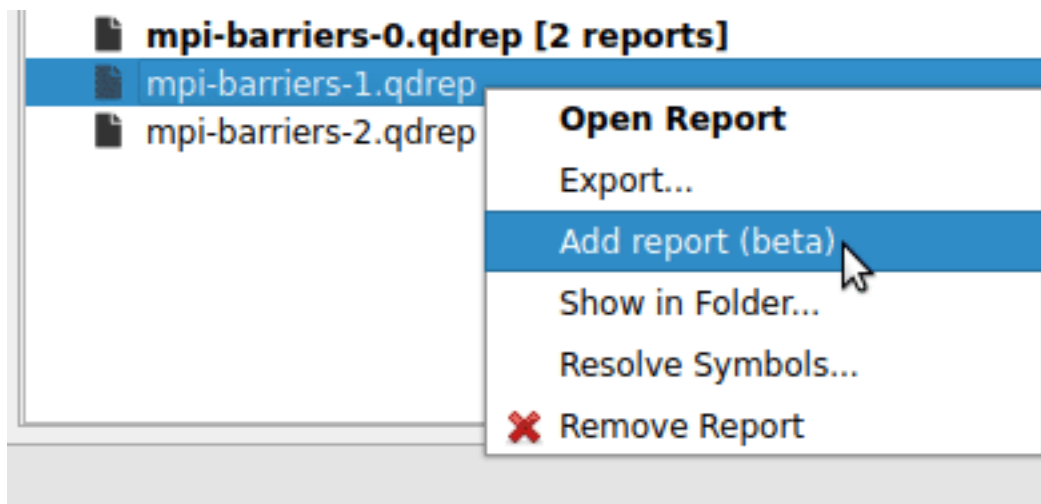
Chapter 23.

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)**



23.1. 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 the same TSC value corresponds to very close UTC times. UTC time difference must be below 1 second in this case. This method is expected to only work for reports collected on the same physical machine.

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.

23.2. 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 (default) — is used when reports are coming from different physical machines, and no hardware resources are shared in these reports. This mode is used by default, 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 activate this mode, specify the same value of **NSYS_SYSTEM_ID** when collecting the reports.

The following diagrams demonstrate typical cases:

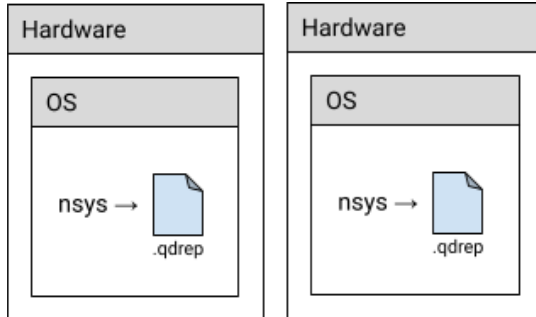


Fig 1. Different hardware (default mode)

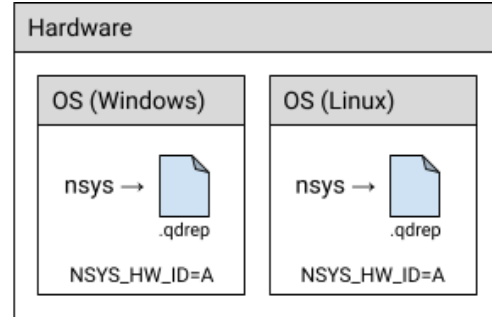


Fig 2. Same hardware, different systems (VMs)

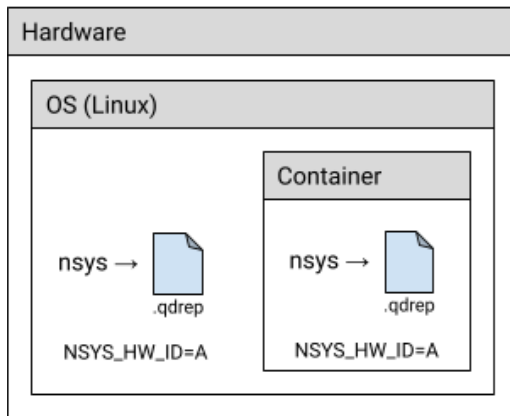


Fig 3. Same hardware, different systems (host and container)

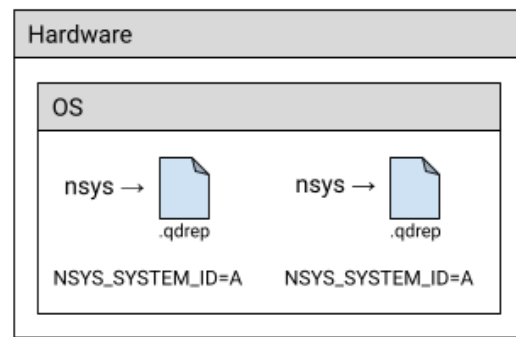


Fig 4. Same system

23.3. 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 <MPI-options> ./myApp
# Run MPI job and profile each instance of the application:
mpirun <MPI-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 <MPI-options> nsys profile -o report-%p  
<nsys-options> ./myApp
```

For convenience, the MPI rank can be encoded into the report filename. Specifics depend on the MPI implementation. For Open MPI, use the following command to create report files based on the global rank value:

```
mpirun <MPI-options> nsys profile -o 'report-  
%q{OMPI_COMM_WORLD_RANK}' <nsys-options> ./myApp
```

For MPICH, use the following command:

```
mpirun <MPI-options> nsys profile -o 'report-%q{PMI_RANK}' <nsys-  
options> ./myApp
```

23.4. 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 24.

USING NSIGHT SYSTEMS EXPERT SYSTEM

The Nsight Systems expert system is an emerging feature in Nsight Systems 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

Expert System View 5 Settings

AsynMemcpy with Pageable Memory **1**

The following APIs use PAGEABLE memory which causes asynchronous CUDA memcpy operations to block and be executed synchronously. This leads to low GPU utilization.
Suggestion: If applicable, use PINNED memory instead. **2**

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

CLI command: **3**
 nsys analyze -r async-memcpy-pageable /home/joan/proj/qdrep/simpleMultiGPU_multiRule.sqlite

A context menu is available to correlate the table entry with the timeline. The options are the same as the Events View:

- ▶ Highlight selected on timeline (double-click)
- ▶ Show current 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 CUDA rules in the expert system. They are described below. Additional rules will be made available in a future version of Nsight Systems.

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

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:
 - ▶ CUDA 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 CUDA 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 25.

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.exstab` ELF sections. `.ARM.exstab` 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.

Chapter 26.

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, and by using the JDWP protocol on Android.

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, not Windows or Android.)

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.

26.1. 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 -1** 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.

26.2. 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



The launcher mechanism is more complex and less automated than the LD_PRELOAD option, but gives more control to the user.

Chapter 27.

IMPORT NVTXT

ImportNvtx 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: NvtxImport 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 nvtx file.
- ▶ **ClockMonotonicRaw** — timestamps values in nvtx file are considered to be gathered on the same target as the report file which is to be merged with nvtx using `clock_gettime(CLOCK_MONOTONIC_RAW, ...)` call.
- ▶ **CNTVCT** — timestamps values in nvtx file are considered to be gathered on the same target as the report file which is to be merged with nvtx 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 nvtx file:

```
--cmd create -n [--nvtx] arg -o [--output] arg [-m [--mode] mode_name mode_args] [--target <Hw:Vm>] [--update_report_time]
```

Merge nvtx file to existing report file:

```
--cmd merge -i [--input] arg -n [--nvtx] 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 [--nvtx_a arg --nvtx_b arg]
```

- ▶ **lin** - insert with linear equation

```
--mode lin --ns_a arg --freq arg [--nvtx_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

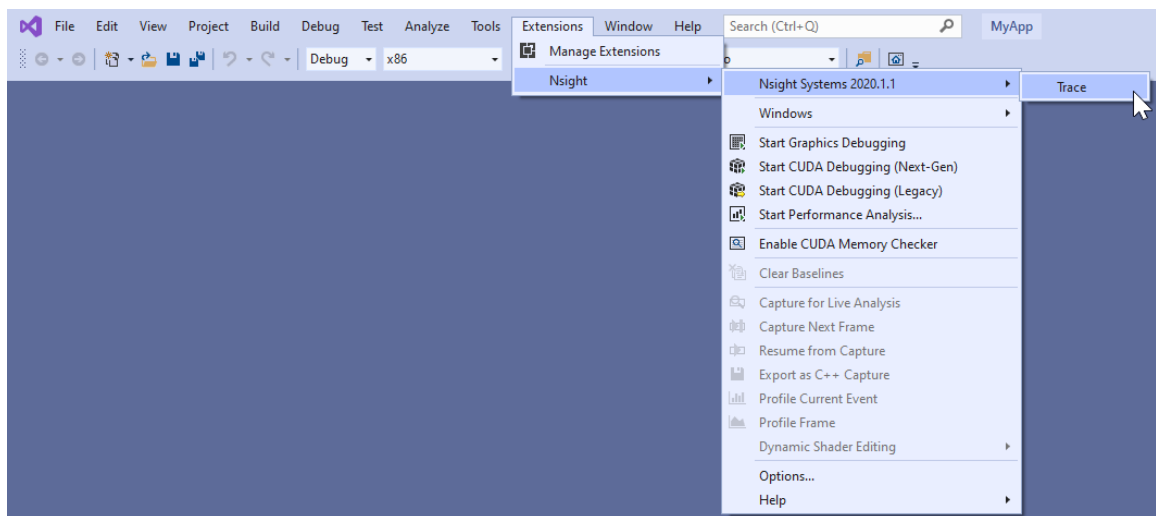
```
ImportNvtxt --cmd merge -i Report.nsys-rep -n Sample.nvtxt -o NewReport.nsys-rep
```


Chapter 28.

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 29.

TROUBLESHOOTING

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.

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.

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.

GUI Troubleshooting

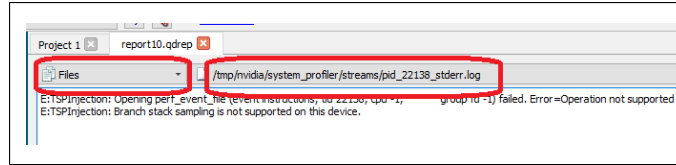
If opening the Nsight Systems Linux GUI fails with the following error, you may be missing some required libraries:

```
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.
```

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.



Android Targets

When connecting to an Android-based device, Nsight Systems installs its executable and library files into the following directory:

```
/data/local/tmp/com.nvidia.nightsystems.tools/
```

Logs on the target device are collected into this file:

```
/data/local/tmp/com.nvidia.nightsystems.tools/nsys.log
```

To enable verbose logging on the target device, follow these steps:

1. Close the host application.
2. Place nvlog.config from host directory to **/sdcard/** directory on target.
3. Restart the target device.
4. From ADB shell, launch the following command:

```
/data/local/tmp/com.nvidia.nightsystems.tools/nsys --daemon --debug
```

On rooted Android devices, the command above should be started from superuser (e.g., **adb shell su -c ...**).

5. Start the host application and connect to the target device.

Please note that in some cases, debug logging can significantly slow down the profiler

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.
-l	--process-list		Print global process IDs list
-s	--sym-file	filename	Path to symbol file

Short	Long	Argument	Description
-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>*<SymbolServer> Available only on Windows.
-n	--ignore-nt-sym-path		Ignore the symbol locations stored in the _NT_SYMBOL_PATH environment

Short	Long	Argument	Description
			variable. Available only on Windows.

Verbose 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 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 2021.2
```

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 2021.2\target-windows-x64
```

- ▶ Remote Windows target:

```
C:\Users\\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.

QNX Troubleshooting

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.

Chapter 30.

OTHER RESOURCES

Looking for information to help you use Nsight Systems the most effectively? Here are some more resources you might want to review:

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](#)

Blog Posts

NVIDIA developer blogs, these are longer form, technical pieces written by tool and domain experts.

- ▶ [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](#)

Training Seminars

[2018 NCSA Blue Waters Webinar - Introduction to NVIDIA Nsight Systems](#)

Conference Presentations

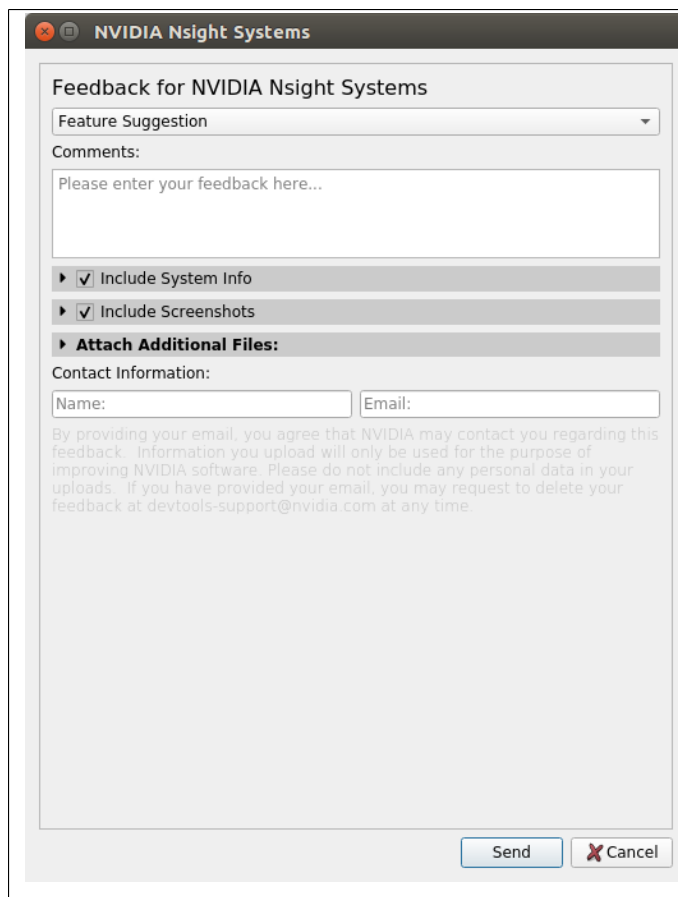
- ▶ [GTC 2020 - Rebalancing the Load: Profile-Guided Optimization of the NAMD Molecular Dynamics Program for Modern GPUs using Nsight Systems](#)
- ▶ [GTC 2020 - Scaling the Transformer Model Implementation in PyTorch Across Multiple Nodes](#)
- ▶ [GTC 2019 - Using Nsight Tools to Optimize the NAMD Molecular 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.



The image shows a dialog box titled "NVIDIA Nsight Systems" with a subtitle "Feedback for NVIDIA Nsight Systems". It contains a dropdown menu for "Feature Suggestion", a text area for "Comments" with the placeholder "Please enter your feedback here...", three checked checkboxes for "Include System Info", "Include Screenshots", and "Attach Additional Files:", and a "Contact Information" section with "Name:" and "Email:" input fields. A disclaimer is present below the contact fields, and "Send" and "Cancel" buttons are at the bottom right.

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