Intuitive Performance Engineering at the Exascale with TAU and TAU Commander

Presented to
ATPESC 2017 Participants

Dr. John C. Linford
ParaTools, Inc.

Q Center, St. Charles, IL (USA)
Date 08/08/2017

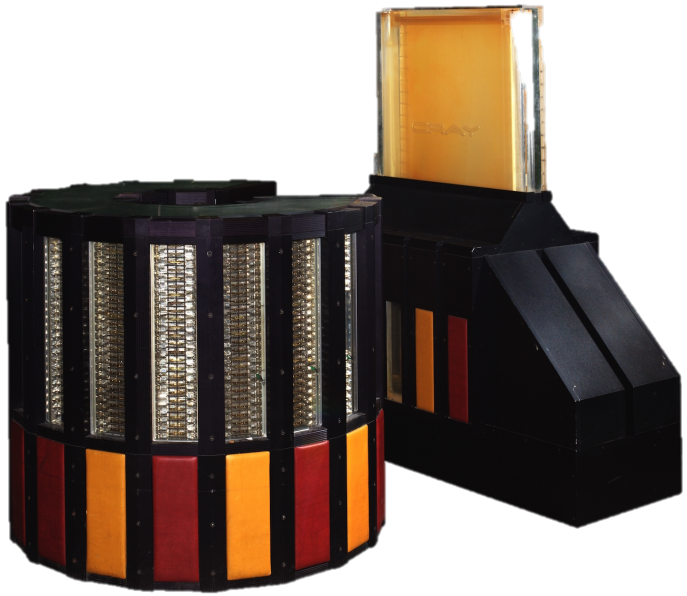
EXASCALE COMPUTING PROJECT

National Nuclear Security Administration

U.S. DEPARTMENT OF ENERGY | Office of Science

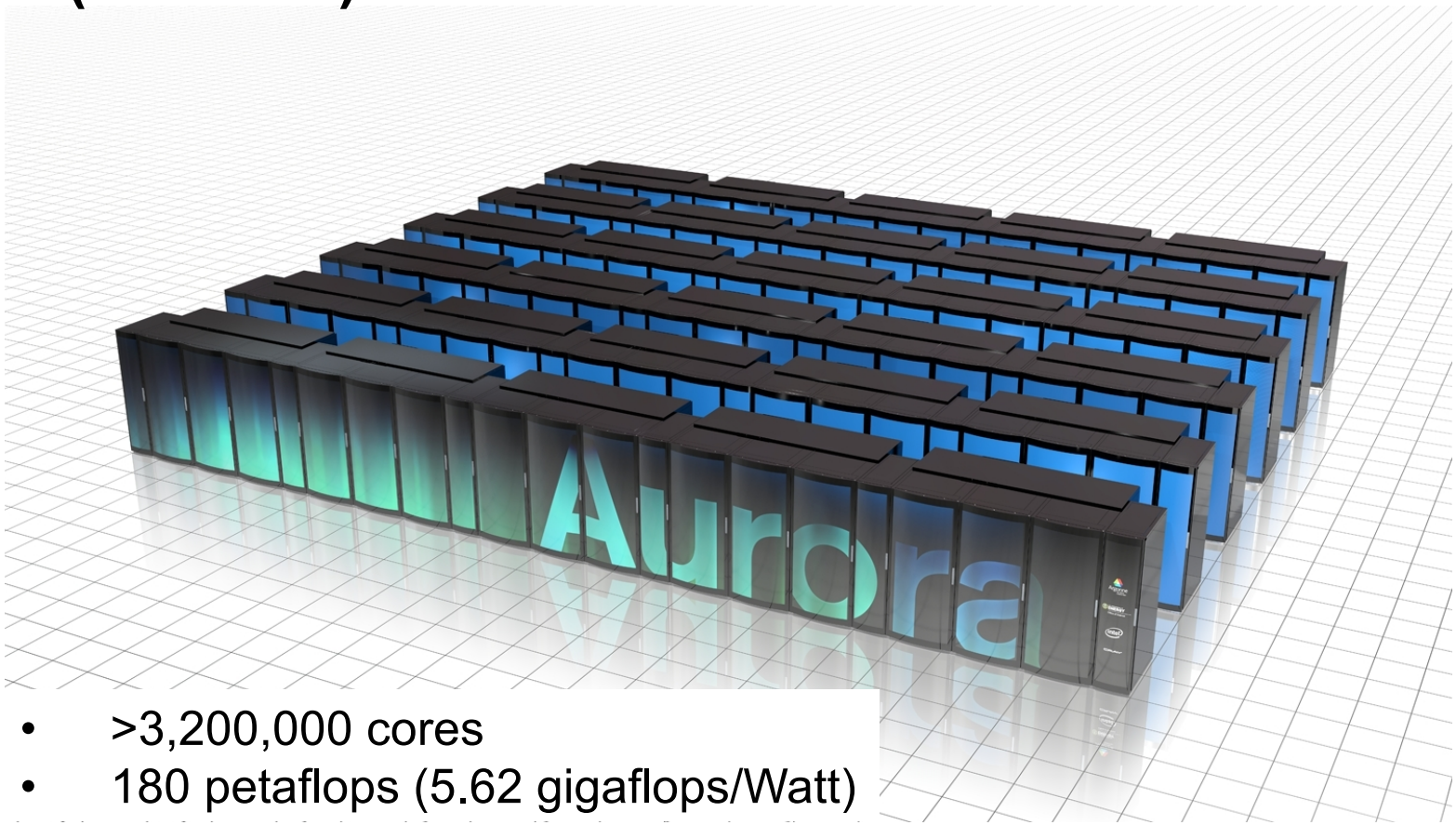
Argonne NATIONAL LABORATORY

Cray-2 (1985)



- 4 vector processors
- 1.9 gigaflops (0.0095 gigaflops/Watt)

Aurora (1985+34)



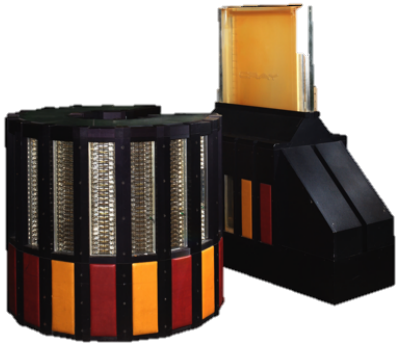
- >3,200,000 cores
- 180 petaflops (5.62 gigaflops/Watt)

Argonne NATIONAL LABORATORY

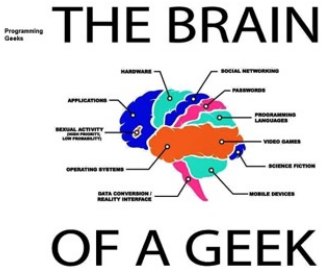
ECP EXASCALE COMPUTING PROJECT

Your Brain is Not Enough

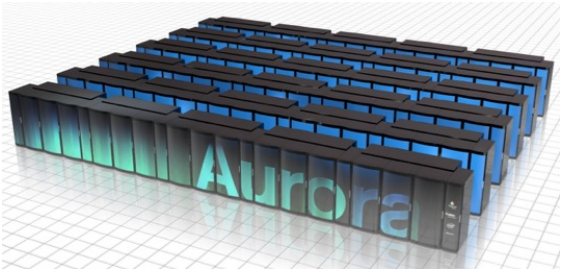
- Supercomputers are incomprehensibly complex.
- Naïve optimization may harm performance.
- Performance engineering **tools are essential** for realizing performance at scale.



<



<

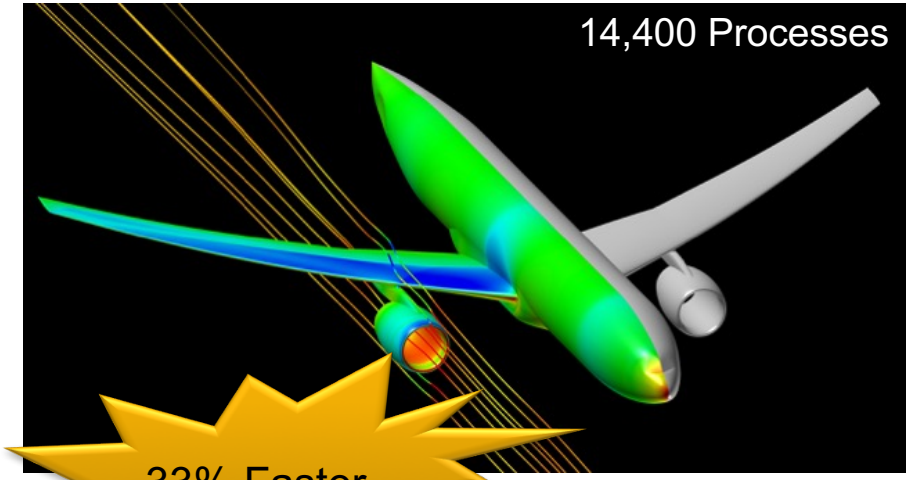


Argonne NATIONAL LABORATORY

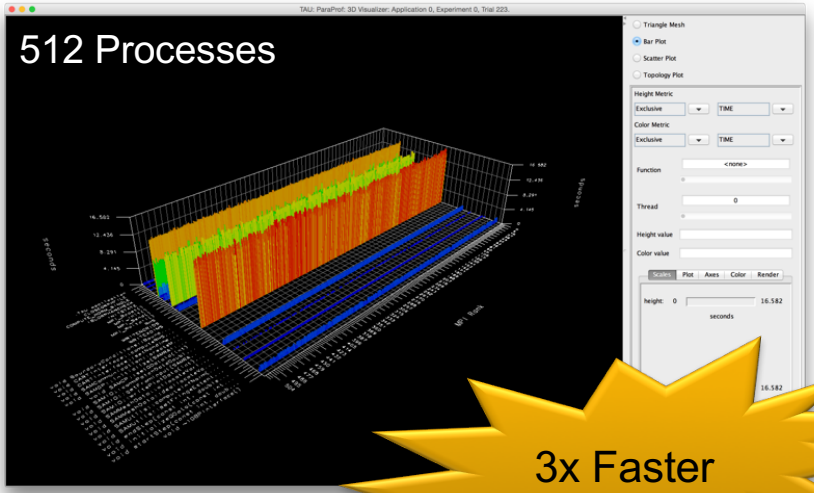
ECP EXASCALE COMPUTING PROJECT

NASA, DOD, DOE, Industry

"These days I get excited about 1-2% speedups that I find....quite unusual to find something of this magnitude these days, especially with just a 2-line fix in the code! :)"



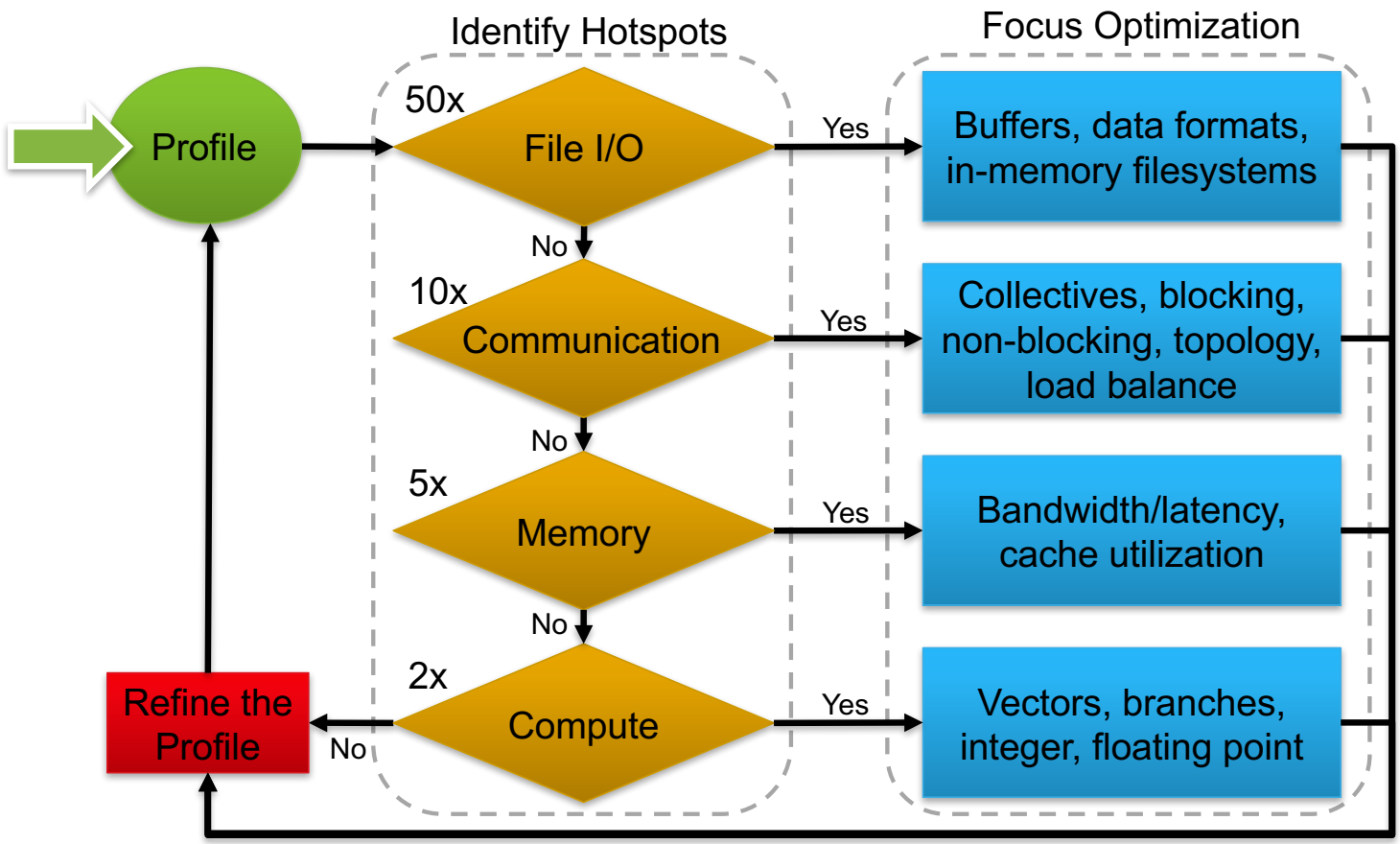
33% Faster



3x Faster

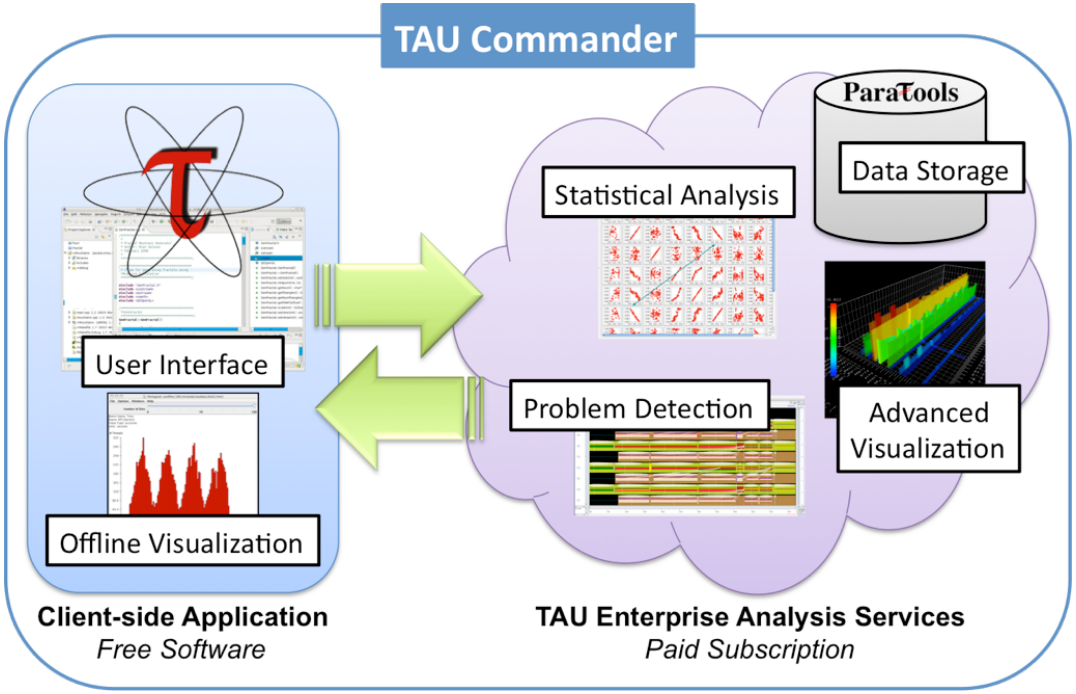
Software Performance Engineering

Identifying and Resolving Performance Issues



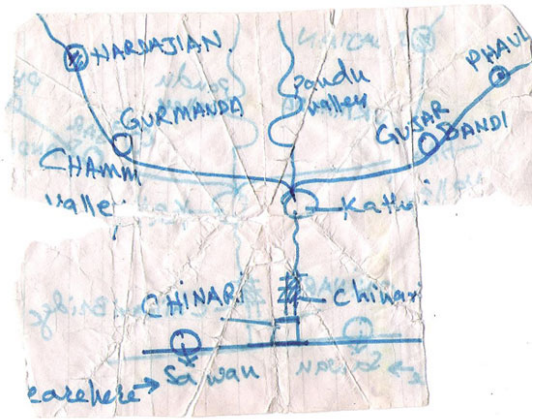
TAU Commander

- **Universal tool or integrated toolkit**
- **Unbiased, accurate measurements**
  - File I/O: serial and parallel
  - Communication: inter- and intra-node
  - Memory: allocation and access
  - CPU: vectorization, cache utilization, etc.
- **Minimal overhead**
  - Provide multiple measurement methods
  - Focus on one performance aspect at a time
- **Easy to use**
  - Intuitive, systematic, and well documented
  - Easy to understand and configure



TAU Commander's Approach

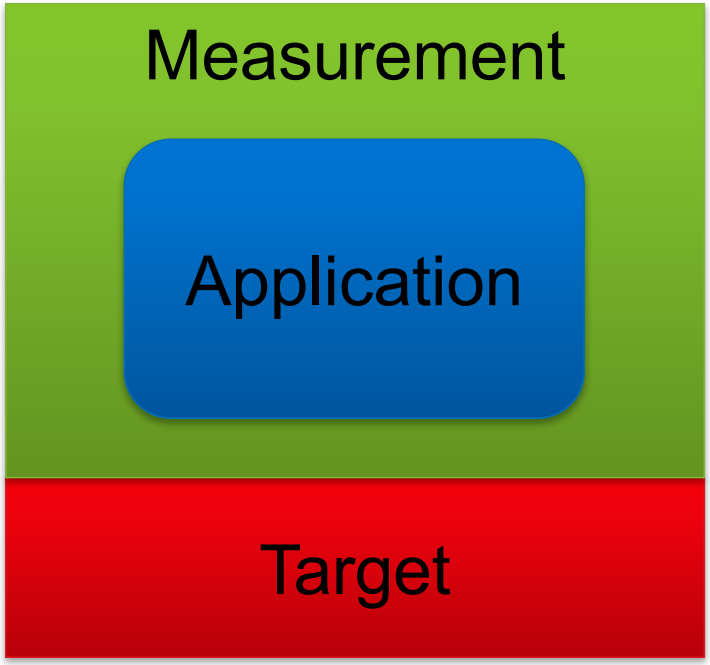
- Say where you're going, not how to get there
- **Experiments** give **context** to the user's actions
  - Defines desired metrics and measurement approach
  - Defines operating environment
  - Establishes a baseline for error checking



vs.

T-A-M Model for Performance Engineering

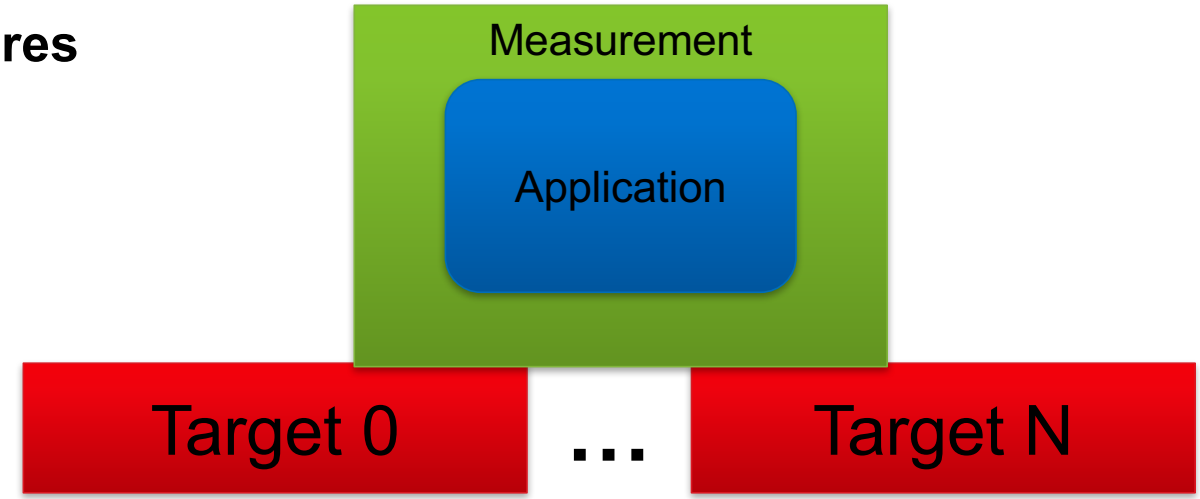
- **Target**
  - Installed software
  - Available compilers
  - Host architecture/OS
- **Application**
  - MPI, OpenMP, CUDA, OpenACC, etc.
- **Measurement**
  - Profile, trace, or both
  - Sample, source inst…



Experiment =
(Target, Application, Measurement)

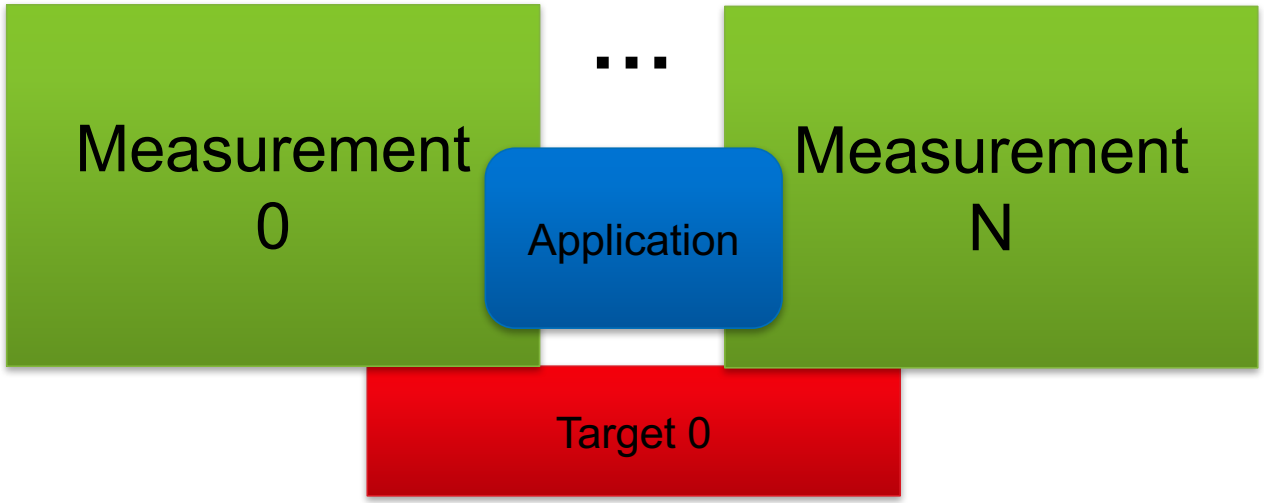
Which platform is best for my application?

- **Many targets:**
  - **Different MPI implementations**
  - **Different CPU architectures**
  - **GPU vs MIC**
  - **Cray vs SGI**
- **One measurement**
- **One application**



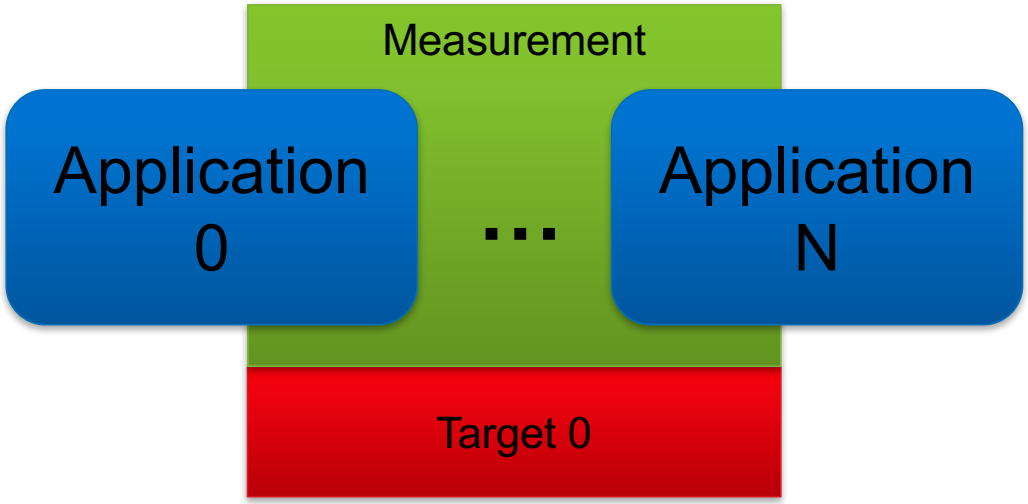
What are the performance characteristics of my application?

- One target
- Many measurements:
  - File I/O
  - Communication
  - Memory allocation
  - Performance counters
  - Vectorization
- One application



How well does my target perform various tasks?

- One target
- One measurement
- Many applications:
  - Compute bound
    - Dense LA
  - Memory bound
    - Sparse LA
    - Graph
  - Scaling
    - Thread-level
    - Process-level



Getting Started with TAU Commander

1. **tau** initialize
2. **tau** oshf90 *.f90 -o foo
3. **tau** oshrun -np 64 ./foo
4. **tau** show

Just put `**tau**` in front of everything and see what happens.

- This works on any supported system, even if TAU is not installed or has not been configured appropriately.
- TAU and all its dependencies will be downloaded and installed if required.

Argonne NATIONAL LABORATORY
ECP EXASCALE COMPUTING PROJECT

TAU Commander Online Help

jlinford — ssh cori.nersc.gov — 80×47

```
jlinford@cori09 ~/workspace/openshmem17/applications/ISx $ tau --help
usage: tau [arguments] <subcommand> [options]

TAU Commander 1.0a [ www.taucommander.com ]

Positional Arguments:
  <subcommand>    See subcommand descriptions below.
  [options]       Options to be passed to <subcommand>.

Optional Arguments:
  -V, --version   Show program's version number and exit.
  -h, --help      Show this help message and exit.
  -q, --quiet     Suppress all output except error messages.
  -v, --verbose   Show debugging messages.

Configuration Subcommands:
  application     Create and manage application configurations.
  experiment      Create and manage experiments.
  measurement     Create and manage measurement configurations.
  project         Create and manage project configurations.
  target          Create and manage target configurations.
  trial           Create and manage experiment trials.

Subcommands:
  build           Instrument programs during compilation and/or linking.
  configure       Configure TAU Commander.
  dashboard       Show all project components.
  help            Show help for a command or suggest actions for a file.
  initialize      Initialize TAU Commander.
  select          Create a new experiment or select an existing experiment.

Shortcuts:
  tau <compiler>  Execute a compiler command
                  - Example: tau gcc *.c -o a.out
                  - Alias for 'tau build <compiler>'
  tau <program>   Gather data from a program
                  - Example: tau ./a.out
                  - Alias for 'tau trial create <program>'
  tau metrics     Show metrics available in the current experiment
                  - Alias for 'tau target metrics'
  tau select      Select configuration objects to create a new experiment
                  - Alias for 'tau experiment create'
  tau show        Show data from the most recent trial
                  - Alias for 'tau trial show'

See 'tau help <subcommand>' for more information on <subcommand>.
jlinford@cori09 ~/workspace/openshmem17/applications/ISx $
```

jlinford — ssh cori.nersc.gov — 80×35

```
jlinford@cori09 ~/workspace/openshmem17/applications/ISx $ tau app cre --help
usage: tau application create <application_name> [arguments]

Create application configurations.

Optional Arguments:
  -@ <level>            Create the application at the specified storage
                        level.
                          - <level>: project, user, system
                          - default: project
  -h, --help            Show this help message and exit.

Application Arguments:
  <application_name>    Application configuration name.
  --cuda [T/F]          Application uses NVIDIA CUDA.
                          - default: False
  --linkage <linkage>   Application linkage.
                          - <linkage>: static, dynamic
                          - default: static
  --mpc [T/F]           Application uses MPC.
                          - default: False
  --mpi [T/F]           Application uses MPI.
                          - default: False
  --opencl [T/F]        Application uses OpenCL.
                          - default: False
  --openmp [T/F]        Application uses OpenMP.
                          - default: False
  --pthreads [T/F]      Application uses pthreads.
                          - default: False
  --select-file path    Specify selective instrumentation file.
  --shmem [T/F]         Application uses SHMEM.
                          - default: False
  --tbb [T/F]           Application uses Thread Building Blocks (TBB).
                          - default: False
jlinford@cori09 ~/workspace/openshmem17/applications/ISx $
```

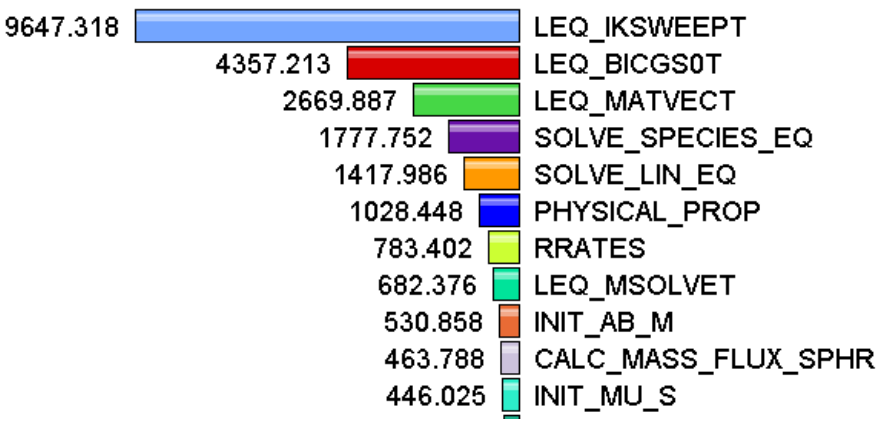

Argonne NATIONAL LABORATORY

ECP EXASCALE COMPUTING PROJECT

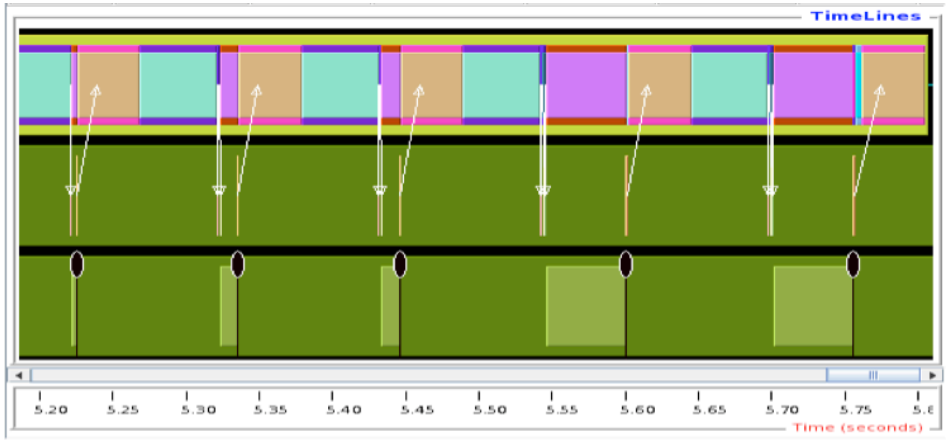
Gathering Performance Data

Measurement Approaches

Profiling shows **how much time**

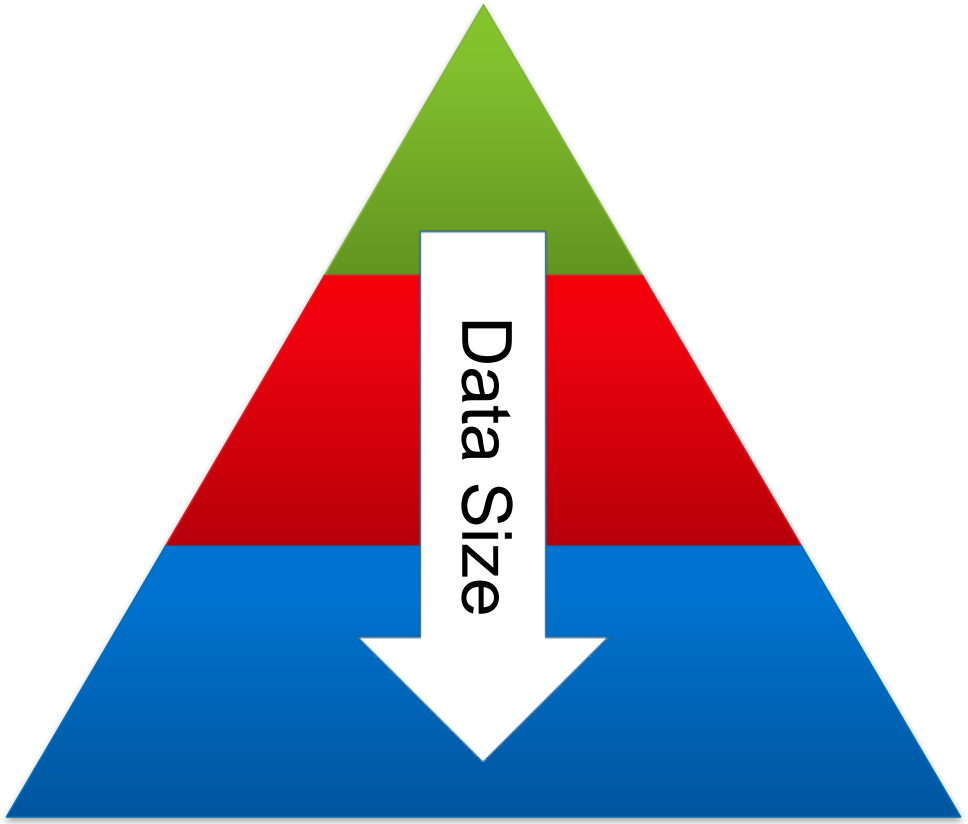


Tracing shows the **order of events**

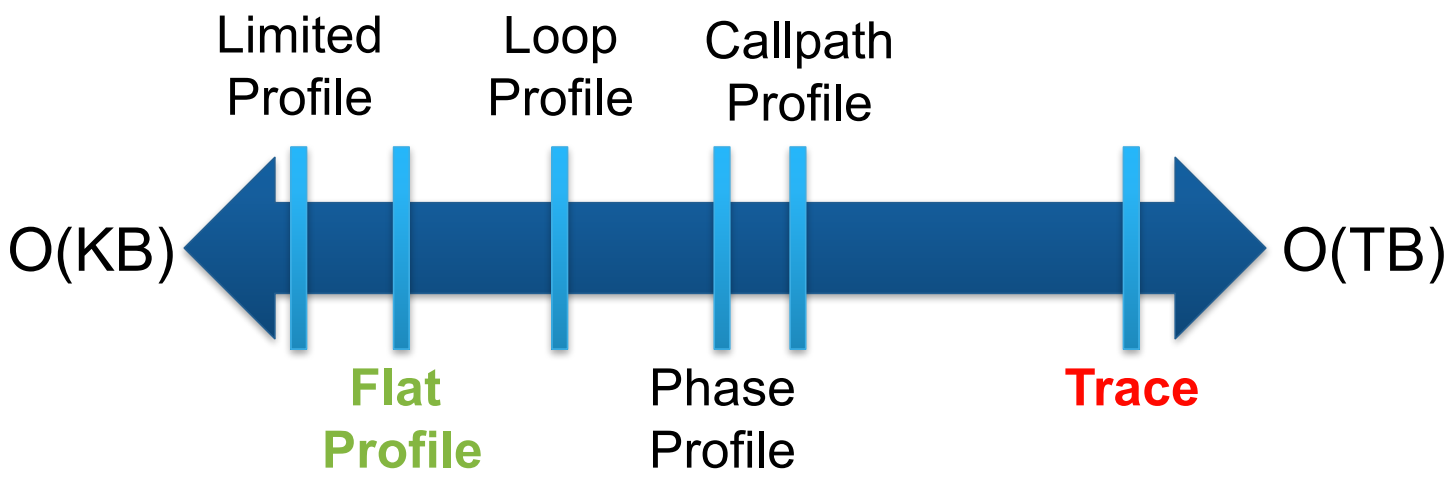


Types of Performance Profiles

- ***Flat*** profiles
  - Metric (e.g., time) spent in an event
  - Exclusive/inclusive, # of calls, child calls, …
- ***Callpath*** profiles
  - Time spent along a calling path (edges in callgraph)
  - "*main=> f1 => f2 => MPI_Send*"
- ***Phase*** profiles
  - Flat profiles under a phase (nested phases allowed)
  - Default "main" phase
  - Supports static or dynamic (e.g. per-iteration) phases



How much data do you want?



All levels support multiple metrics/counters

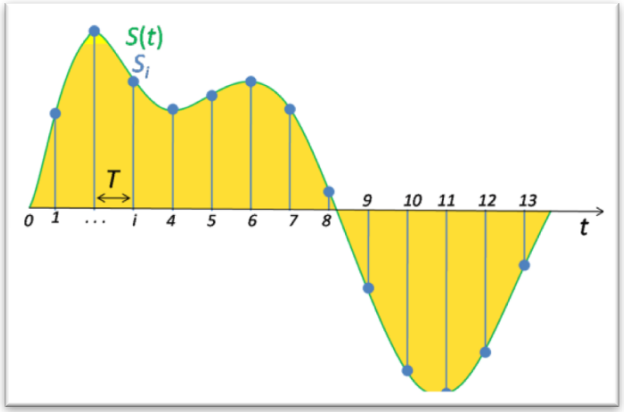
Performance Data Measurement

Direct via Probes

```
call TAU_START('potential')
// code
call TAU_STOP('potential')
```

- Exact measurement
- Fine-grain control
- Calls inserted into code

Indirect via Sampling



- No code modification
- Minimal effort
- Relies on debug symbols (**-g**)

TAU Commander Case Study

EXASCALE COMPUTING PROJECT

Step 1: Initialize TAU Project

```
$ cd ISx

$ tau initialize --shmem
```

- Creates a new project configuration using defaults
- Project files exist in a directory named ".tau"
- Like git, all directories below the directory containing the ".tau" directory can access the project
  - E.g. `tau dashboard` works in miniapp1/baseline

Project Initialization (`tau initialize`)

ParaTools — ssh cori.nersc.gov — 120×50

```
jlinford@cori09 ~/workspace/openshmem17/applications/ISx $ tau initialize --shmem
[TAU] Cray C++ compiler '/opt/cray/pe/craype/2.5.7/bin/CC' wraps
[TAU]     '/opt/intel/compilers_and_libraries_2017.2.174/linux/bin/intel64/icpc'
[TAU] Cray Fortran compiler '/opt/cray/pe/craype/2.5.7/bin/ftn' wraps
[TAU]     '/opt/intel/compilers_and_libraries_2017.2.174/linux/bin/intel64/ifort'
[TAU] Cray C compiler '/opt/cray/pe/craype/2.5.7/bin/cc' wraps
[TAU]     '/opt/intel/compilers_and_libraries_2017.2.174/linux/bin/intel64/icc'
[TAU] Cray MPI C compiler '/opt/cray/pe/craype/2.5.7/bin/cc' wraps
[TAU]     '/opt/intel/compilers_and_libraries_2017.2.174/linux/bin/intel64/icc'
[TAU] Cray MPI C++ compiler '/opt/cray/pe/craype/2.5.7/bin/CC' wraps
[TAU]     '/opt/intel/compilers_and_libraries_2017.2.174/linux/bin/intel64/icpc'
[TAU] Cray MPI Fortran compiler '/opt/cray/pe/craype/2.5.7/bin/ftn' wraps
[TAU]     '/opt/intel/compilers_and_libraries_2017.2.174/linux/bin/intel64/ifort'
[TAU] Cray SHMEM C compiler '/opt/cray/pe/craype/2.5.7/bin/cc' wraps
[TAU]     '/opt/intel/compilers_and_libraries_2017.2.174/linux/bin/intel64/icc'
[TAU] Cray SHMEM C++ compiler '/opt/cray/pe/craype/2.5.7/bin/CC' wraps
[TAU]     '/opt/intel/compilers_and_libraries_2017.2.174/linux/bin/intel64/icpc'
[TAU] Cray SHMEM Fortran compiler '/opt/cray/pe/craype/2.5.7/bin/ftn' wraps
[TAU]     '/opt/intel/compilers_and_libraries_2017.2.174/linux/bin/intel64/ifort'
[TAU] Created a new project named 'ISx'.
[TAU] Added application 'ISx' to project configuration 'ISx'.
[TAU] Added target 'cori09' to project configuration 'ISx'.
[TAU] Added measurement 'sample' to project configuration 'ISx'.
[TAU] Added measurement 'profile' to project configuration 'ISx'.
[TAU] Added measurement 'trace' to project configuration 'ISx'.
[TAU] Created a new experiment 'cori09-ISx-sample'
[TAU] Installing PDT to '/global/project/projectdirs/m88/jlinford/taucmdr-test/system/pdt/77f947dd'
[TAU] Using PDT source archive '/global/project/projectdirs/m88/jlinford/taucmdr-test/system/src/pdt.tgz'
[TAU] Checking contents of '/global/project/projectdirs/m88/jlinford/taucmdr-test/system/src/pdt.tgz'
[TAU] Completed in 8.276 seconds
[TAU] Extracting '/global/project/projectdirs/m88/jlinford/taucmdr-test/system/src/pdt.tgz' to create
[TAU]     '/dev/shm/tmpQl6qTD/./pdtoolkit-3.24'
[TAU] Completed in 5.216 seconds
[TAU] Configuring PDT...
[TAU] Completed in 17.439 seconds
[TAU] Compiling PDT...
[TAU] Completed in 6.394 seconds
[TAU] Installing PDT...
[TAU] Completed in 0.115 seconds
[TAU] Checking installed files...
[TAU] Completed in 0.115 seconds
[TAU] Setting file permissions...
[TAU] Completed in 0.136 seconds
[TAU] Verifying PDT installation...
[TAU] Installing TAU Performance System at
[TAU]     '/global/project/projectdirs/m88/jlinford/taucmdr-test/system/tau/./tau-2.26.2'
[TAU] Configuring TAU...
[TAU] Completed in 26.358 seconds
[TAU] Compiling and installing TAU...
[TAU] 5.0 seconds [CPU: 32.4
```

Compiler detection

Project initialization

Download and install PDT

TAU installation progress

Argonne NATIONAL LABORATORY

ECP EXASCALE COMPUTING PROJECT

Project Dashboard (`tau dashboard`)

ParaTools — ssh cori.nersc.gov — 120×50

```
== Project Configuration (/global/project/projectdirs/m88/jlinford/openshmem17/applications/ISx/.tau/project.json) ==

| Name | Targets | Applications |        Measurements        | # Experiments |
|  ISx | cori09  |      ISx     | sample, profile, trace     |       1       |

== Targets in project 'ISx' ==========================================================================

|  Name  | Host OS | Host Arch | Host Compilers | MPI Compilers | SHMEM Compilers |
| cori09 |   CNL   |   x86_64  |      Cray      |      Cray     |       Cray      |

== Applications in project 'ISx' ======================================================================

| Name | Linkage | OpenMP | Pthreads | TBB | MPI | CUDA | OpenCL | SHMEM | MPC |
|  ISx | static  |   No   |    No    | No  | No  | No   |   No   |  Yes  | No  |

== Measurements in project 'ISx' ======================================================================

|  Name   | Profile | Trace | Sample | Source Inst. | Compiler Inst. | OpenMP | CUDA | I/O | MPI | SHMEM |
| sample  |   tau   | none  |  Yes   |    never     |     never      | ignore |  No  | No  | No  |  Yes  |
| profile |   tau   | none  |   No   |  automatic   |     never      | ignore |  No  | No  | No  |  Yes  |
|  trace  |  none   | slog2 |   No   |  automatic   |     never      | ignore |  No  | No  | No  |  Yes  |

== Experiments in project 'ISx' =======================================================================

|      Name      |  Trials  | Data Size | Target | Application | Measurement | TAU Makefile |
| cori09-ISx-    |    0     |   0.0B    | cori09 |     ISx     |   sample    | Makefile.tau-
|      sample    |          |           |        |             |             |   intel-
|                |          |           |        |             |             |   3f5a233a-
|                |          |           |        |             |             |   shmem-pdt

Selected Experiment: cori09-ISx-sample
```


Argonne NATIONAL LABORATORY

ECP EXASCALE COMPUTING PROJECT

Step 2: Use `tau` to compile

ParaTools — ssh cori.nersc.gov — 120×50

```
1 CC = tau cc
2 LD = $(CC)
3 DEBUGFLAGS = -g -p -O0 -DDEBUG
4 OPTFLAGS = -O3 -DNDEBUG -xCORE-AVX2
5 CFLAGS += -Wall -Wextra -std=c99 #$(OPTFLAGS)
6 LDLIBS += -lrt -lm
7 LDFLAGS +=
```

Prepend `**tau**` command to compiler command

Compile as normal

ParaTools — ssh cori.nersc.gov — 120×44

```
jlinford@cori09 ~/workspace/openshmem17/applications/ISx/SHMEM $ make optimized
tau cc -Wall -Wextra -std=c99  -O3 -DNDEBUG -xCORE-AVX2 -D SCALING_OPTION=1 -c pcg_basic.c -o obj/pcg_basic.o_s
[TAU] Cray SHMEM C compiler '/opt/cray/pe/craype/2.5.7/bin/cc' wraps
[TAU]     '/opt/intel/compilers_and_libraries_2017.2.174/linux/bin/intel64/icc'
[TAU] TAU_MAKEFILE=/global/project/projectdirs/m88/jlinford/taucmdr-test/system/tau/./tau-2.26.2/craycnl/lib/Makefile.tau-intel-3f5a233a-shmem-pdt
[TAU] TAU_OPTIONS=-optNoCompInst -optLinkOnly -optQuiet
[TAU] tau_cc.sh -g -Wall -Wextra -std=c99 -O3 -DNDEBUG -xCORE-AVX2 -D SCALING_OPTION=1 -c pcg_basic.c -o
[TAU]     obj/pcg_basic.o_s
```

- TAU Commander constructs a new compilation command line.
  - May replace compiler commands with TAU's compiler wrapper scripts.
  - May set environment variables, parse configuration files, etc.
  - If no changes are required then nothing is changed.

Argonne NATIONAL LABORATORY
ECP EXASCALE COMPUTING PROJECT

Step 3: Use `tau` to run

```
jlinford — ssh cori.nersc.gov — 150×39
jlinford@nid00030 ~/workspace/openshmem17/applications/ISx/SHMEM $ tau srun -n 64 ./bin/isx.strong 134217728 output_strong
[TAU]
[TAU] == BEGIN Experiment at 2017-06-21 19:57:33.728778 ==========================================================
[TAU]
[TAU] PROFILEDIR=/global/project/projectdirs/m88/jlinford/openshmem17/applications/ISx/.tau/ISx/cori09-ISx-sample/0
[TAU] SCOREP_ENABLE_TRACING=false
[TAU] TAU_CALLPATH=1
[TAU] TAU_CALLPATH_DEPTH=100
[TAU] TAU_CALLSITE=1
[TAU] TAU_COMM_MATRIX=0
[TAU] TAU_METRICS=TIME,
[TAU] TAU_PROFILE=1
[TAU] TAU_SAMPLING=1
[TAU] TAU_THROTTLE=1
[TAU] TAU_THROTTLE_NUMCALLS=100000
[TAU] TAU_THROTTLE_PERCALL=10
[TAU] TAU_TRACE=0
[TAU] TAU_TRACK_HEAP=0
[TAU] TAU_VERBOSE=0
[TAU] TRACEDIR=/global/project/projectdirs/m88/jlinford/openshmem17/applications/ISx/.tau/ISx/cori09-ISx-sample/0
[TAU] srun -n 64 ./bin/isx.strong 134217728 output_strong
ISx v1.1
  Number of Keys per PE: 2097152
  Max Key Value: 268435456
  Bucket Width: 4194304
  Number of Iterations: 1
  Number of PEs: 64
  STRONG Scaling!
Average total time (per PE): 0.170602 seconds
Average all2all time (per PE): 0.023284 seconds
[TAU] Trial 0 produced 64 profile files.
[TAU]
[TAU] == END Experiment at 2017-06-21 19:57:38.794719 ==================================================
[TAU]
[TAU] Experiment: cori09-ISx-sample
[TAU] Current working directory: /global/project/projectdirs/m88/jlinford/openshmem17/applications/ISx/SHMEM
[TAU] Data size: 1110404 bytes
[TAU] Command: srun -n 64 ./bin/isx.strong 134217728 output_strong
jlinford@nid00030 ~/workspace/openshmem17/applications/ISx/SHMEM $
```

Prepend `**tau**` command to command line

ment variables

Application executes, possibly with tau_exec

New data is added to the performance database

Argonne NATIONAL LABORATORY

ECP EXASCALE COMPUTING PROJECT

Step 4: Use `tau` to view data (`tau show`)

TAU: ParaProf: Mean Statistics - cori09-ISx-sample.trial0.ppk

Name	Exclusive TIME	Inclusive TIME ▽	Calls	Child Calls
.TAU application	0.306	1.347	1	326
void shmem_init(void) C	0.498	0.498	1	0
void shmem_finalize(void) C	0.462	0.462	1	0
[CONTEXT] .TAU application	0	0.32	6.406	0
[SUMMARY] main [{/global/project/projectdirs/m88/jlinford/openshmem17/applications/ISx/SHMEM/isx.c}]	0.262	0.262	5.172	0
[SAMPLE] main [{/global/project/projectdirs/m88/jlinford/openshmem17/applications/ISx/SHMEM/isx.c} {497}]	0.149	0.149	2.922	0
[SAMPLE] main [{/global/project/projectdirs/m88/jlinford/openshmem17/applications/ISx/SHMEM/isx.c} {374}]	0.041	0.041	0.812	0
[SAMPLE] main [{/global/project/projectdirs/m88/jlinford/openshmem17/applications/ISx/SHMEM/isx.c} {376}]	0.036	0.036	0.719	0
[SAMPLE] main [{/global/project/projectdirs/m88/jlinford/openshmem17/applications/ISx/SHMEM/isx.c} {378}]	0.011	0.011	0.219	0
[SAMPLE] main [{/global/project/projectdirs/m88/jlinford/openshmem17/applications/ISx/SHMEM/isx.c} {260}]	0.008	0.008	0.172	0
[SAMPLE] main [{/global/project/projectdirs/m88/jlinford/openshmem17/applications/ISx/SHMEM/isx.c} {381}]	0.005	0.005	0.094	0
[SAMPLE] main [{/global/project/projectdirs/m88/jlinford/openshmem17/applications/ISx/SHMEM/isx.c} {476}]	0.004	0.004	0.078	0
[SAMPLE] main [{/global/project/projectdirs/m88/jlinford/openshmem17/applications/ISx/SHMEM/isx.c} {379}]	0.004	0.004	0.078	0
[SAMPLE] main [{/global/project/projectdirs/m88/jlinford/openshmem17/applications/ISx/SHMEM/isx.c} {380}]	0.004	0.004	0.078	0
[SUMMARY] pcg32_boundedrand_r [{/global/project/projectdirs/m88/jlinford/openshmem17/applications/ISx/SHMEM/pcg_basic.c}]	0.057	0.057	1.203	0
[SAMPLE] __close_nocancel [{/home/abuild/rpmbuild/BUILD/glibc-2.19/nptl/../sysdeps/unix/syscall-template.S} {81}]	0.001	0.001	0.016	0
[SAMPLE] __wrap_shmem_n_pes [{/global/project/projectdirs/m88/jlinford/openshmem17/applications/ISx/SHMEM/bin/isx.strong} {0}]	0.001	0.001	0.016	0
void shmem_int_put(int *, const int *, size_t, int) C	0.037	0.037	126	0
long long shmem_longlong_fadd(long long *, long long, int) C	0.018	0.018	128	0
void *shmem_malloc(size_t) C	0.015	0.015	16	0
void shmem_barrier_all(void) C	0.009	0.009	27	0
void shmem_fcollect64(void *, const void *, size_t, int, int, int, long *) C	0.001	0.001	7	0
void shmem_collect32(void *, const void *, size_t, int, int, int, long *) C	0	0	1	0
void shmem_longlong_sum_to_all(long long *, const long long *, size_t, int, int, int, long long *, long *) C	0	0	1	0
int shmem_my_pe(void) C	0	0	9	0
void shmem_free(void *) C	0	0	8	0
int shmem_n_pes(void) C	0	0	1	0
[CALLSITE] void shmem_init(void) C	0.996	0.996	2	0
[CONTEXT] [CALLSITE] void shmem_init(void) C	0	0.481	1.688	0
[SAMPLE] __ioctl [{/home/abuild/rpmbuild/BUILD/glibc-2.19/misc/../sysdeps/unix/syscall-template.S} {81}]	0.473	0.473	1.344	0
[SAMPLE] _pmi_smp_barrier_join [{/usr/src/packages/BUILD/cray-pmi-5.0.10/src/pmi_core/smp_barrier.c} {70}]	0.006	0.006	0.281	0
[SAMPLE] Tau_lite_stop_timer [{/global/project/projectdirs/m88/jlinford/taucmdr-test/system/tau/tau-2.26.2/src/Profile/TauCAPI.cpp} {	0.002	0.002	0.047	0
[SAMPLE] _dmappi_sheap_alloc [{/home/abuild/rpmbuild/BUILD/cray-dmapp-7.1.1/src/dmapp_sheap.c} {318}]	0.001	0.001	0.016	0

Create a New Experiment

Select a new measurement to create a new experiment

ParaTools — ssh cori.nersc.gov — 120×17

```
jlinford@nid00073 ~/workspace/openshmem17/applications/ISx/SHMEM $ tau select profile
[TAU] Created a new experiment 'cori09-ISx-profile'
[TAU] Installing TAU Performance System at
[TAU]     '/global/project/projectdirs/m88/jlinford/taucmdr-test/system/tau/./tau-2.26.2'
[TAU] Configuring TAU...
[TAU] Completed in 155.459 seconds
[TAU] Compiling and installing TAU...
[TAU] Completed in 48.596 seconds
[TAU] Checking installed files...
[TAU] Completed in 10.551 seconds
[TAU] Setting file permissions...
[TAU] Completed in 2.556 seconds
[TAU] Verifying TAU Performance System installation...
[TAU] Selected experiment 'cori09-ISx-profile'.
[TAU] Application rebuild required:
[TAU]   - source_inst changed from 'never' to 'automatic'
jlinford@nid00073 ~/workspace/openshmem17/applications/ISx/SHMEM $
```

TAU Performance System® automatically reconfigured and recompiled.

User advised that an application rebuild is required to use source-based instrumentation.

Argonne NATIONAL LABORATORY
ECP EXASCALE COMPUTING PROJECT

Create and Select KNL Target

Terminal — ssh cori.nersc.gov — 120×35

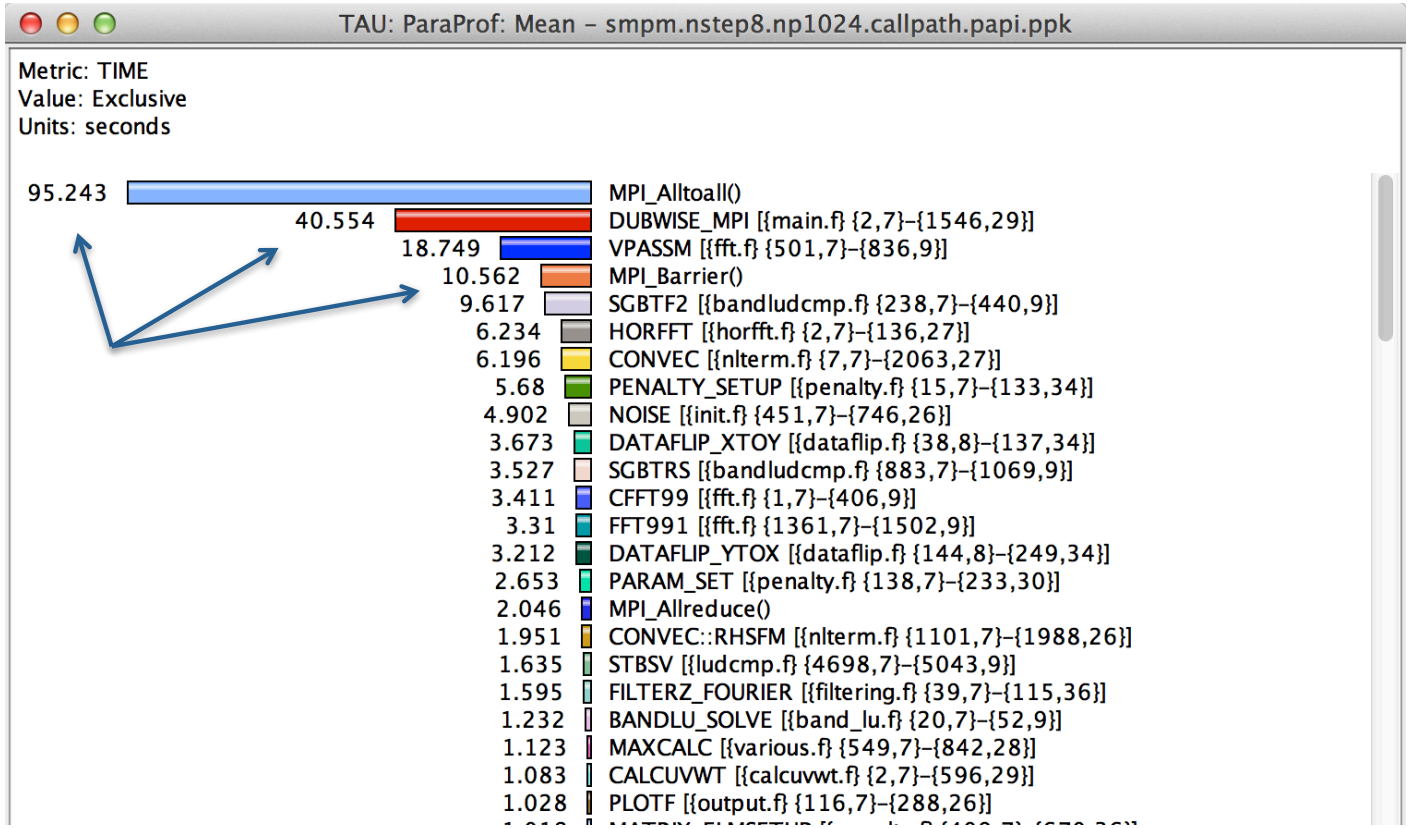
```
jlinford@cori09 ~/workspace/openshmem17/applications/ISx $ tau target copy cori09 cori.KNL --arch=KNL
[TAU] Added target 'cori.KNL' to project configuration 'ISx'.
jlinford@cori09 ~/workspace/openshmem17/applications/ISx $ tau select cori.KNL ISx profile
[TAU] Created a new experiment 'cori.KNL-ISx-profile'
[TAU] Installing PDT to '/global/project/projectdirs/m88/jlinford/taucmdr-test/system/pdt/04860562'
[TAU] Using PDT source archive '/global/project/projectdirs/m88/jlinford/taucmdr-test/system/src/pdt.tgz'
[TAU] Checking contents of '/global/project/projectdirs/m88/jlinford/taucmdr-test/system/src/pdt.tgz'
[TAU] Completed in 8.297 seconds
[TAU] Extracting '/global/project/projectdirs/m88/jlinford/taucmdr-test/system/src/pdt.tgz' to create
[TAU]     '/dev/shm/tmpedFKyo/./pdtoolkit-3.24'
[TAU] Completed in 4.488 seconds
[TAU] Configuring PDT...
[TAU] Completed in 18.205 seconds
[TAU] Compiling PDT...
[TAU] Completed in 5.997 seconds
[TAU] Installing PDT...
[TAU] Completed in 0.116 seconds
[TAU] Checking installed files...
[TAU] Completed in 0.115 seconds
[TAU] Setting file permissions...
[TAU] Completed in 0.179 seconds
[TAU] Verifying PDT installation...
[TAU] Installing TAU Performance System at
[TAU]     '/global/project/projectdirs/m88/jlinford/taucmdr-test/system/tau/./tau-2.26.2'
[TAU] Configuring TAU...
[TAU] Completed in 18.261 seconds
[TAU] Compiling and installing TAU...
[TAU] Completed in 30.248 seconds
[TAU] Checking installed files...
[TAU] Completed in 0.215 seconds
[TAU] Setting file permissions...
[TAU] Completed in 0.484 seconds
[TAU] Verifying TAU Performance System installation...
[TAU] Selected experiment 'cori.KNL-ISx-profile'.
jlinford@cori09 ~/workspace/openshmem17/applications/ISx $
```


Argonne NATIONAL LABORATORY

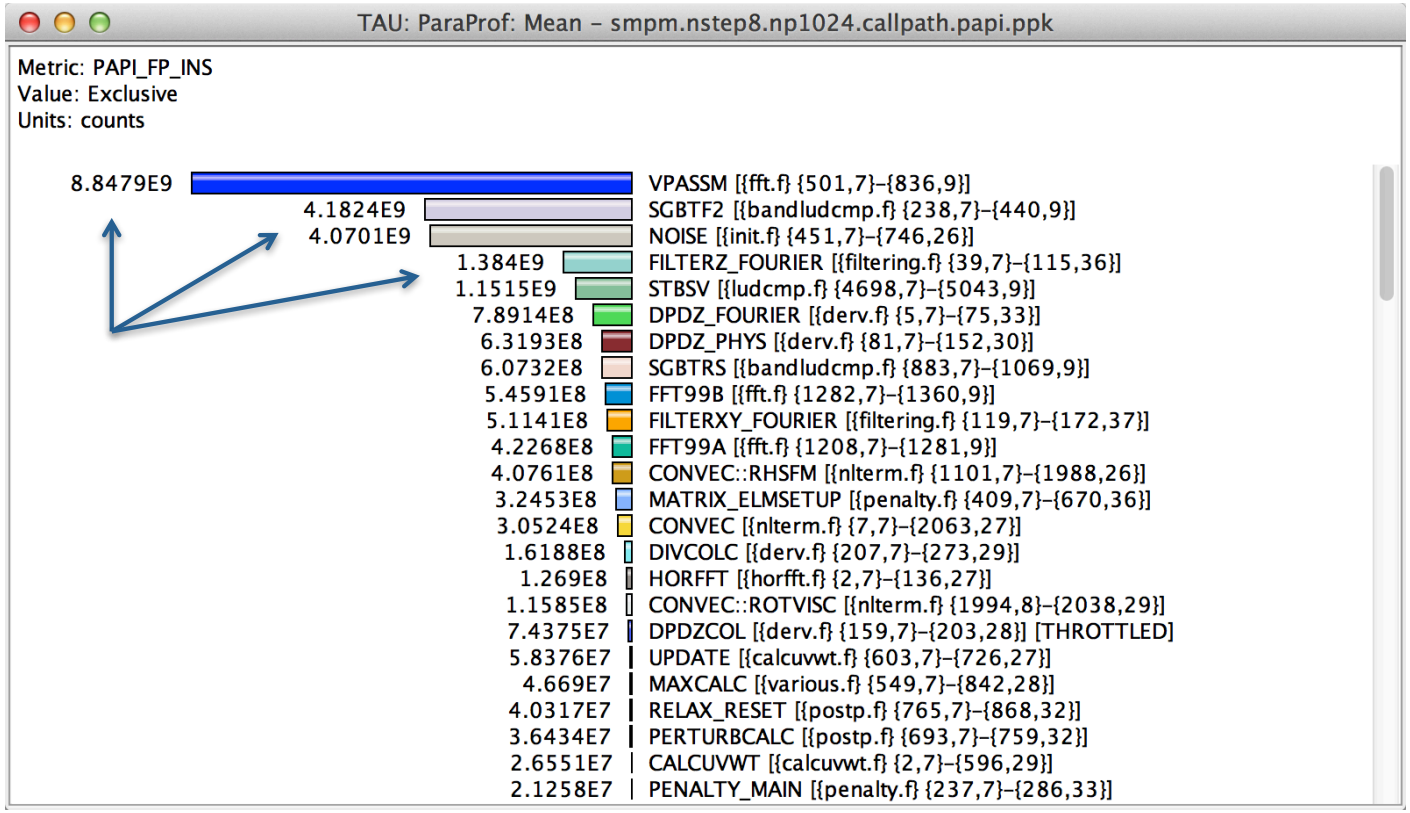
ECP EXASCALE COMPUTING PROJECT

Performance Data Analysis

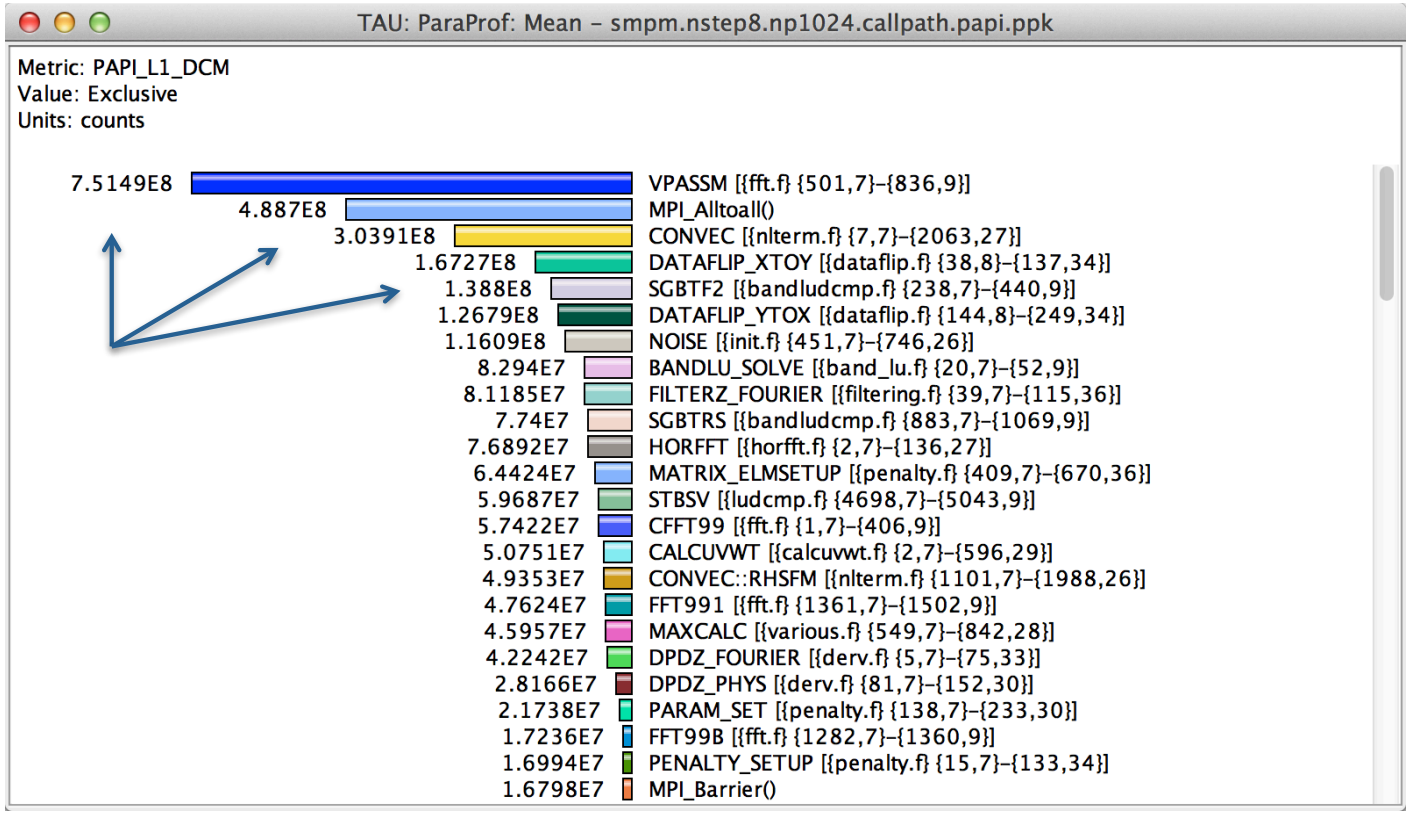
How Much Time per Code Region?



How Many Instructions per Code Region?



How Many L1 or L2 Cache Misses?



How Much Memory Does the Code Use?

TAU: ParaProf: Mean Context Events – sphere_np32_nsteps5_mem.ppk

Name	Total	NumSamples	MaxValue	MinValue	MeanValue	Std. Dev.
.TAU application						
free size (bytes)	14,236,992.16	27,169.781	49,152	1	524.001	2,013.103
malloc size (bytes)	13,132,932	23,292	262,144	1	563.839	4,492.057
MPI_Finalize()						
OurMain()						
free size (bytes)	1,298,918.679	1,495.125	461,766.25	4	868.769	16,928.073
malloc size (bytes)	48,150	20	36,032	11	2,407.5	7,911.992
OurMain						
free size (bytes)	3,465	9	769	32	385	260.2
malloc size (bytes)	4,314	12	769	32	359.5	240.981
<module>						
free size (bytes)	293,088	449	32,564	32	652.757	1,526.875
malloc size (bytes)	311,966	493	32,564	32	632.791	1,460.941
staticCFD						
__init__						
<module>						
Memory Utilization (heap, in KB)		849,270.344	192,825.168	0.078	147,832.141	62,621.576
Message size for all-gather	4,096	1	4,096	4,096	4,096	0
Message size for all-reduce	23,340	843	320	4	27.687	64.653
Message size for all-to-all	104	26	4	4	4	0
Message size for broadcast	24,923	206	8,788	4	120.985	860.992
Message size for reduce	8,912	8	8,788	4	1,114	2,900.511
free size (bytes)	27,417,881,391.51	413,600.719	24,025,667	1	66,290.701	199,538.234
malloc size (bytes)	27,468,709,355.914	435,669.625	24,025,667	0	63,049.402	195,561.193

High-water mark

Argonne NATIONAL LABORATORY

ECP EXASCALE COMPUTING PROJECT

How Much Memory Does the Code Use?

TAU: ParaProf: Mean Context Events – sphere_np32_nsteps5_mem.ppk

Name	Total	NumSamples	MaxValue	MinValue	MeanValue	Std. Dev.
.TAU application						
free size (bytes)	14,236,992.16	27,169.781	49,152	1	524.001	2,013.103
malloc size (bytes)	13,132,932	23,292	262,144	1	563.839	4,492.057
MPI_Finalize()						
OurMain()						
free size (bytes)	1,298,918.679	1,495.125	461,766.25	4	868.769	16,928.073
malloc size (bytes)	48,150	20	36,032	11	2,407.5	7,911.992
OurMain						
free size (bytes)	3,465	9	769	32	385	260.2
malloc size (bytes)	4,314	12	769	32	359.5	240.981
<module>						
free size (bytes)	293,088	449	32,564	32	652.757	1,526.875
malloc size (bytes)	311,966	493	32,564	32	632.791	1,460.941
staticCFD						
__init__						
<module>						
Memory Utilization (heap, in KB)		849,270.344	192,825.168	0.078	147,832.141	62,621.576
Message size for all-gather	4,096	1	4,096	4,096	4,096	0
Message size for all-reduce	23,340	843	320	4	27.687	64.653
Message size for all-to-all	104	26	4	4	4	0
Message size for broadcast	24,923	206	8,788	4	120.985	860.992
Message size for reduce	8,912	8	8,788	4	1,114	2,900.511
free size (bytes)	27,417,881,391.51	413,600.719	24,025,667	1	66,290.701	199,538.234
malloc size (bytes)	27,468,709,355.914	435,669.625	24,025,667	0	63,049.402	195,561.193

Total allocated/deallocated

Argonne NATIONAL LABORATORY

ECP EXASCALE COMPUTING PROJECT

Where is Memory Allocated / Deallocated?

TAU: ParaProf: Mean Context Events – sphere_np32_nsteps5_mem.ppk

Name	Total	NumSamples	MaxValue	MinValue	MeanValue	Std. Dev.
.TAU application						
free size (bytes)	14,236,992.16	27,169.781	49,152	1	524.001	2,013.103
malloc size (bytes)	13,132,932	23,292	262,144	1	563.839	4,492.057
MPI_Finalize()						
OurMain()						
free size (bytes)	1,298,918.679	1,495.125	461,766.25	4	868.769	16,928.073
malloc size (bytes)	48,150	20	36,032	11	2,407.5	7,911.992
OurMain						
free size (bytes)	3,465	9	769	32	385	260.2
malloc size (bytes)	4,314	12	769	32	359.5	240.981
<module>						
free size (bytes)	293,088	449	32,564	32	652.757	1,526.875
malloc size (bytes)	311,966	493	32,564	32	632.791	1,460.941
staticCFD						
__init__						
<module>						
Memory Utilization (heap, in KB)		849,270.344	192,825.168	0.078	147,832.141	62,621.576
Message size for all-gather	4,096	1	4,096	4,096	4,096	0
Message size for all-reduce	23,340	843	320	4	27.687	64.653
Message size for all-to-all	104	26	4	4	4	0
Message size for broadcast	24,923	206	8,788	4	120.985	860.992
Message size for reduce	8,912	8	8,788	4	1,114	2,900.511
free size (bytes)	27,417,881,391.51	413,600.719	24,025,667	1	66,290.701	199,538.234
malloc size (bytes)	27,468,709,355.914	435,669.625	24,025,667	0	63,049.402	195,561.193

Allocation / Deallocation Events

Argonne NATIONAL LABORATORY

ECP EXASCALE COMPUTING PROJECT

What are the I/O Characteristics?

TAU: ParaProf: Context Events for thread: n,c,t, 1,0,0 – samarc_obe_4p_iomem_cp.ppk

Name	Total	MeanValue	NumSamples	MinValue	MaxValue	Std. Dev.
.TAU application						
read()						
fopen64()						
fclose()						
OurMain()						
malloc size	5,235	1,097.174	23	11	12,032	2,851.143
free size	2,707	1,746.692	13	11	12,032	3,660.642
OurMain [{wrapper.py}{3}]						
read()						
malloc size	3,877	323.083	12	32	981	252.72
free size	1,536	219.429	7	32	464	148.122
fopen64()						
fclose()						
<module> [{obe.py}{8}]						
writeRestartData [{samarcInterface.py}{145}]						
samarcWriteRestartData						
write()						
WRITE Bandwidth (MB/s) <file="samarc/restore.00002/nodes.00004/proc.00001">		74.565	117	0	2,156.889	246.386
WRITE Bandwidth (MB/s) <file="samarc/restore.00001/nodes.00004/proc.00001">		77.594	117	0	1,941.2	228.366
WRITE Bandwidth (MB/s)		76.08	234	0	2,156.889	237.551
Bytes Written <file="samarc/restore.00002/nodes.00004/proc.00001">	2,097,552	17,927.795	117	1	1,048,576	133,362.946
Bytes Written <file="samarc/restore.00001/nodes.00004/proc.00001">	2,097,552	17,927.795	117	1	1,048,576	133,362.946
Bytes Written	4,195,104	17,927.795	234	1	1,048,576	133,362.946
open64()						

Write bandwidth per file

Bytes written to each file

Argonne NATIONAL LABORATORY

ECP EXASCALE COMPUTING PROJECT

What are the I/O Characteristics?

Name	Total	NumSamples	MaxValue	MinValue	MeanValue	Std. Dev.
Incl						
Initialize						
LoadBodyEuler						
LoadMesh						
MPI-IO Bytes Written	4,328,712	144	893,152	0	30,060.5	128,042.696
MPI-IO Write Bandwidth (MB/s)		144	196.86	0	3.421	16.87
MPI_Allgatherv()						
MPI_Bcast()						
MPI_Comm_create()						
MPI_File_close()						
MPI_File_open()						
MPI_File_write_all()						
MPI_File_write_at()						
MPI_Finalize()						
MPI_Gather()						
MPI_Gatherv()						

Peak MPI-IO Write Bandwidth

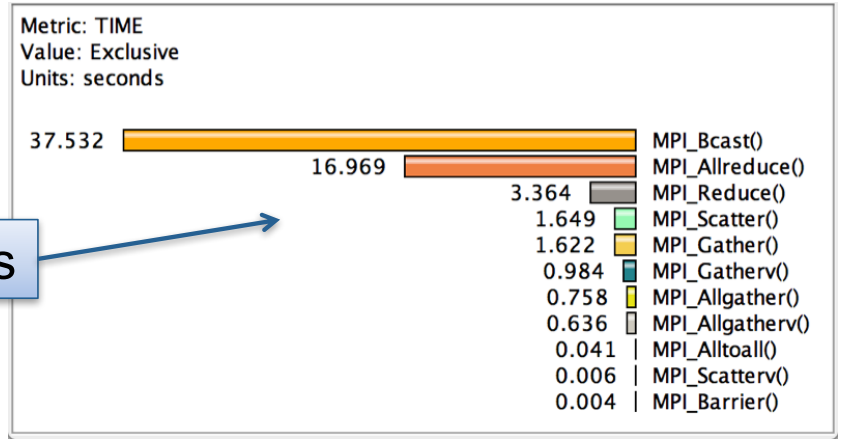
Argonne NATIONAL LABORATORY
ECP EXASCALE COMPUTING PROJECT

How Much Time is spent in Collectives?

Name △	Total	Num...	MaxValue	MinValue	MeanValue	Std. Dev.
▶ MPI_Wait()						
▶ MPI_Waitall()						
Message size for all-gather	305,753,268	72	172,215,296	4	4,246,573.167	22,551,605.859
Message size for all-reduce	163,308	632	21,908	4	258.399	897.725
Message size for all-to-all	112	14	8	8	8	0
Message size for broadcast	692,208,045.5	3,346	18,117,620	0	206,876.284	1,284,673.036
Message size for gather	6,901,452.378	15.312	1,387,306.625	4	450,707.094	483,216.499
Message size for reduce	66,812	1,520	56	4	43.955	21.598
Message size for scatter	63,147.906	146	62,567.906	4	432.52	5,160.063

Message sizes

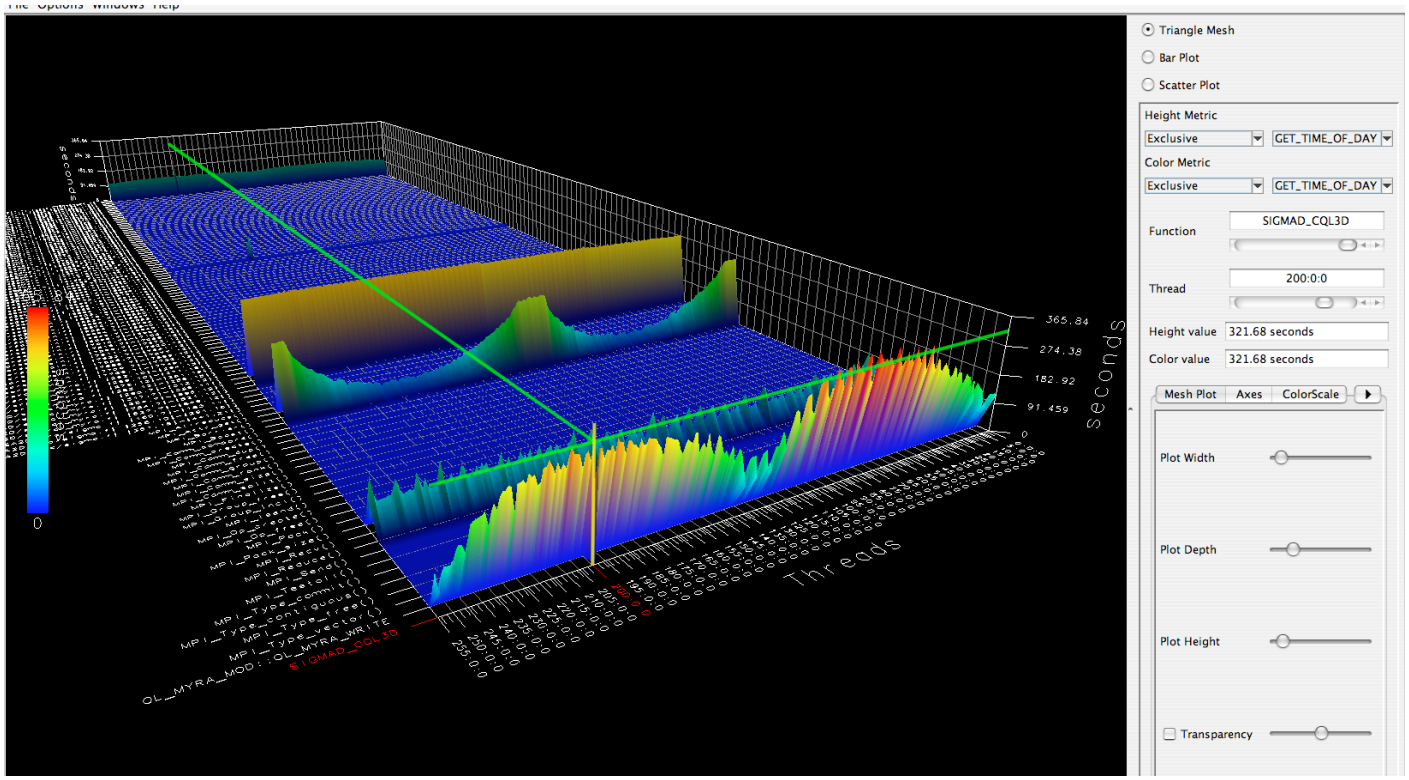
Time spent in collectives



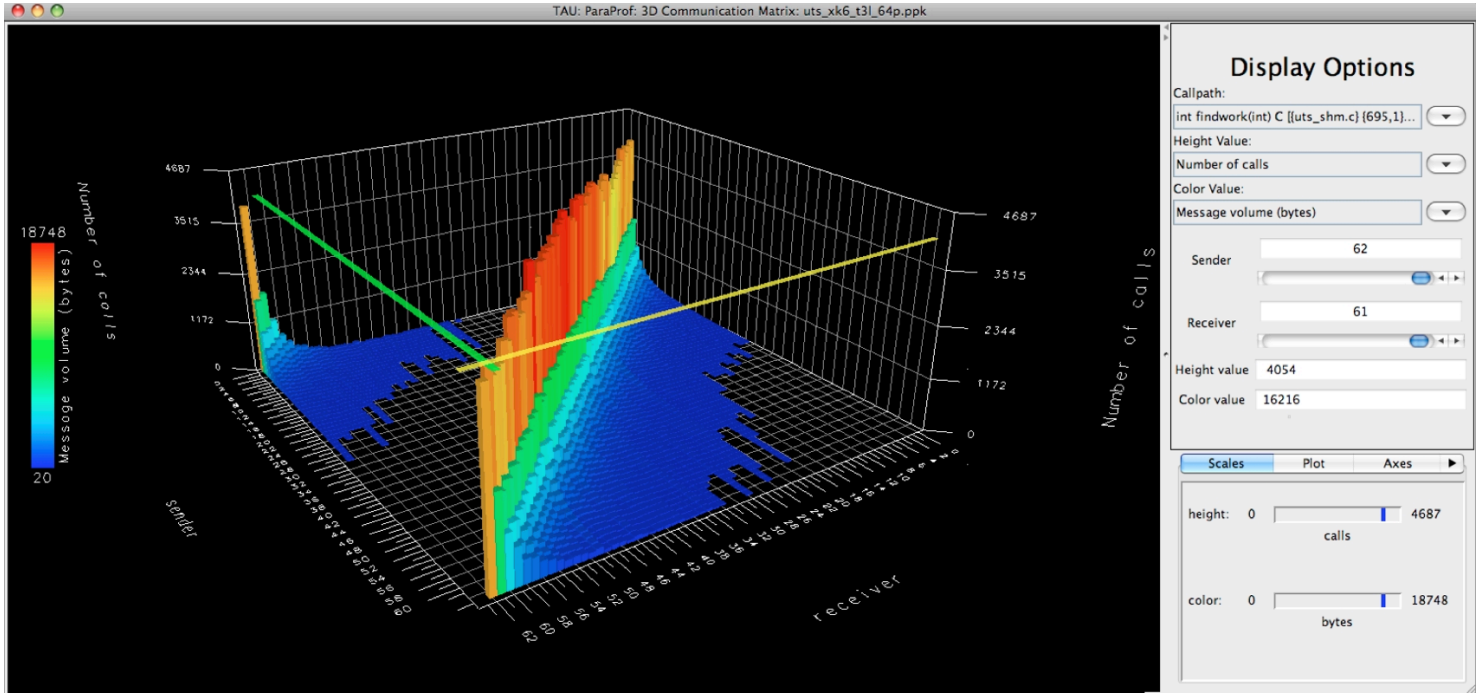
Argonne NATIONAL LABORATORY

ECP EXASCALE COMPUTING PROJECT

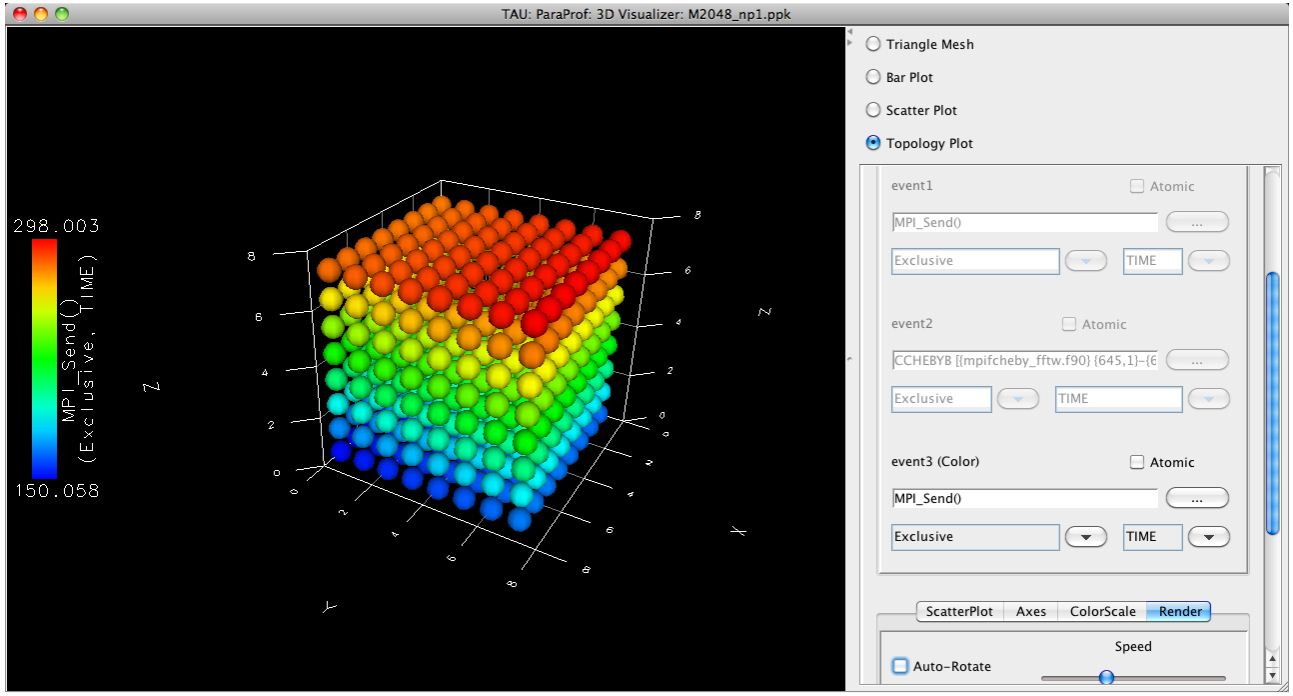
3D Profile Visualization



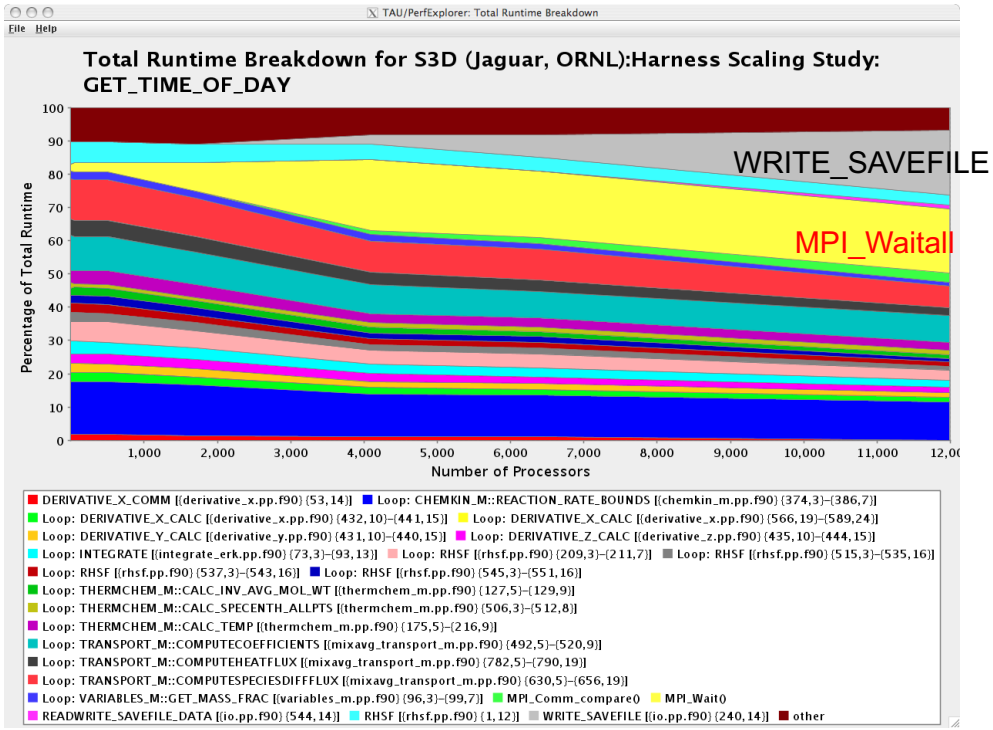
3D Communication Visualization



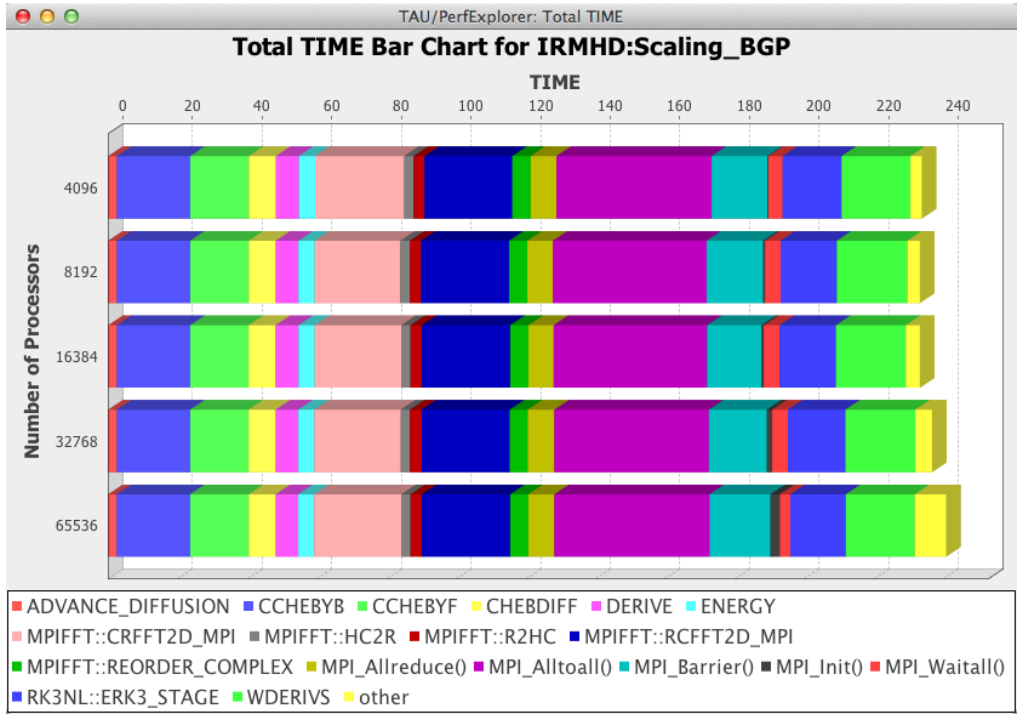
3D Topology Visualization



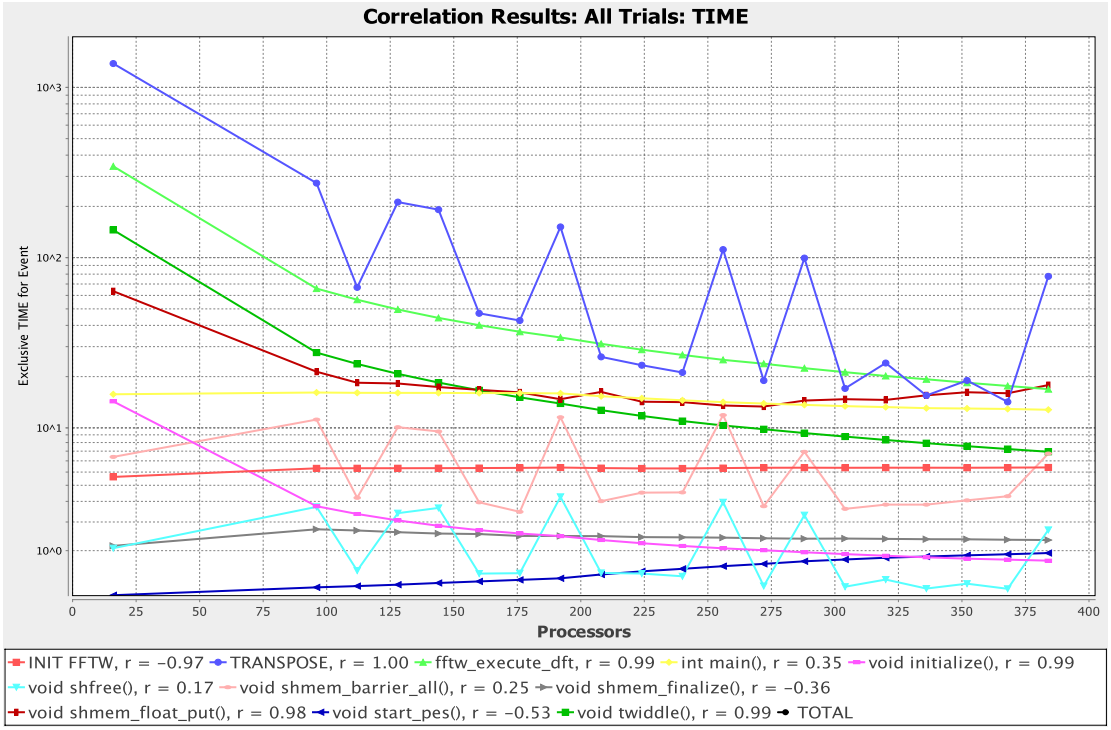
How Does Each Routine Scale?



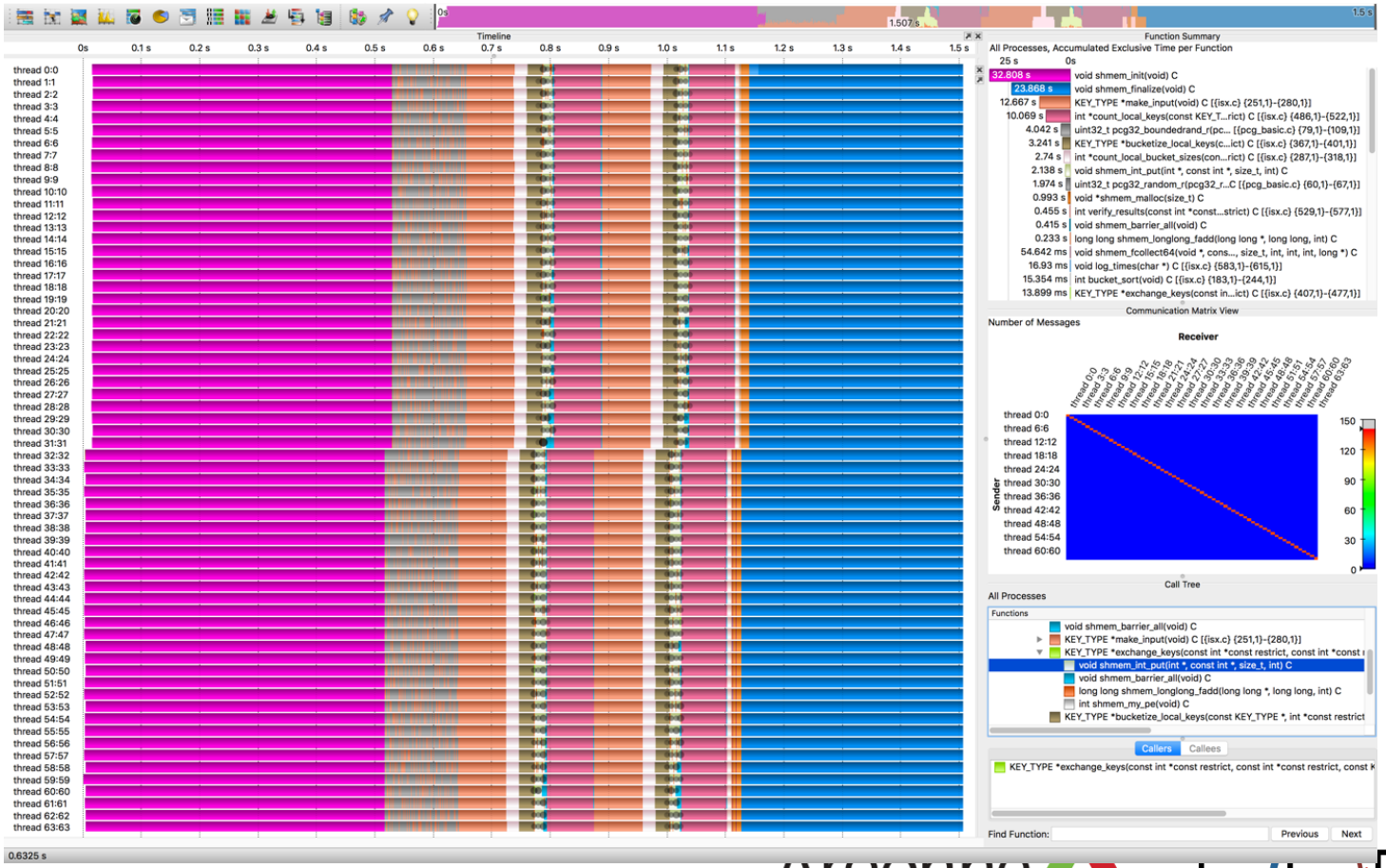
How Does Each Routine Scale?



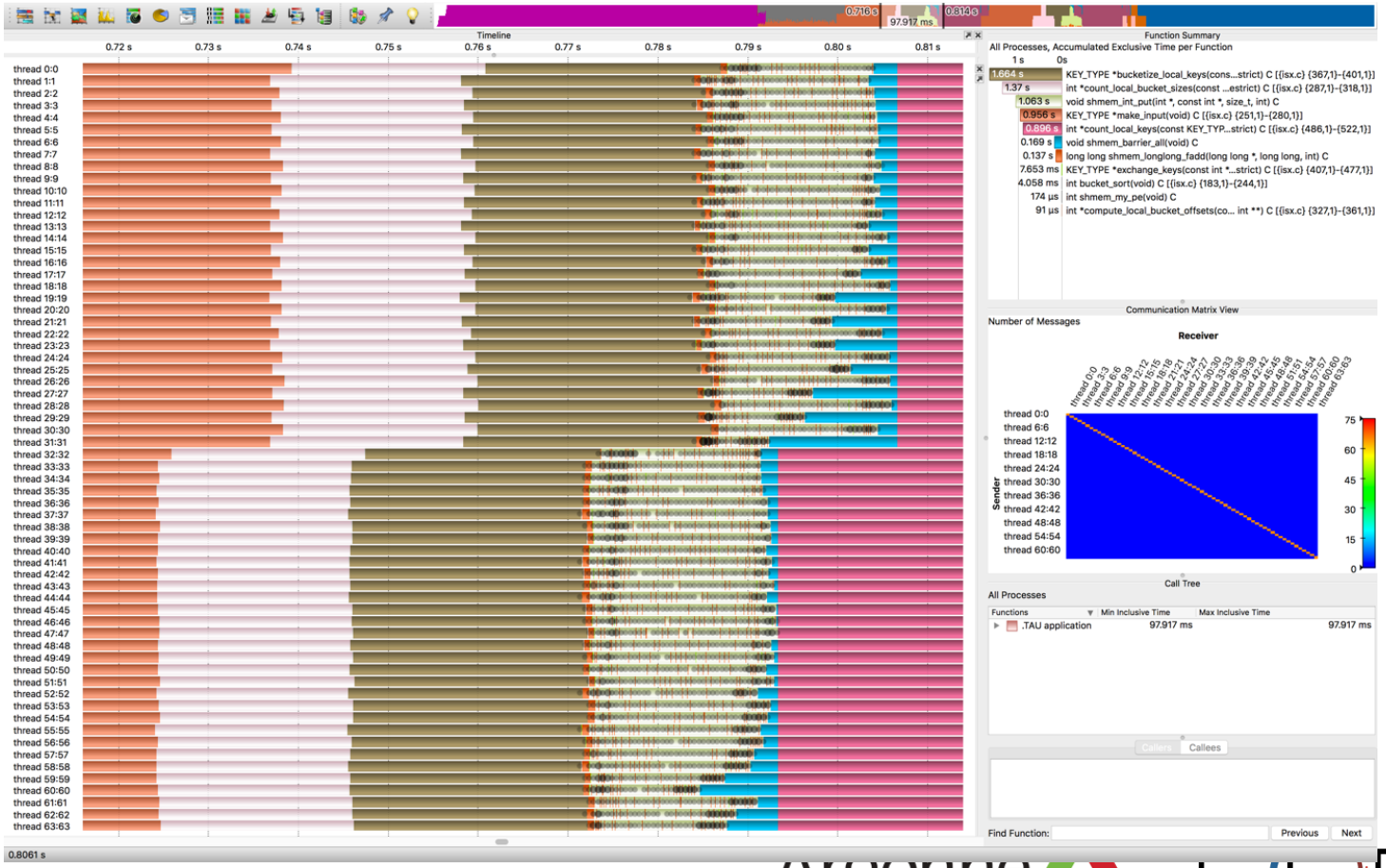
Which Events Correlate with Runtime?



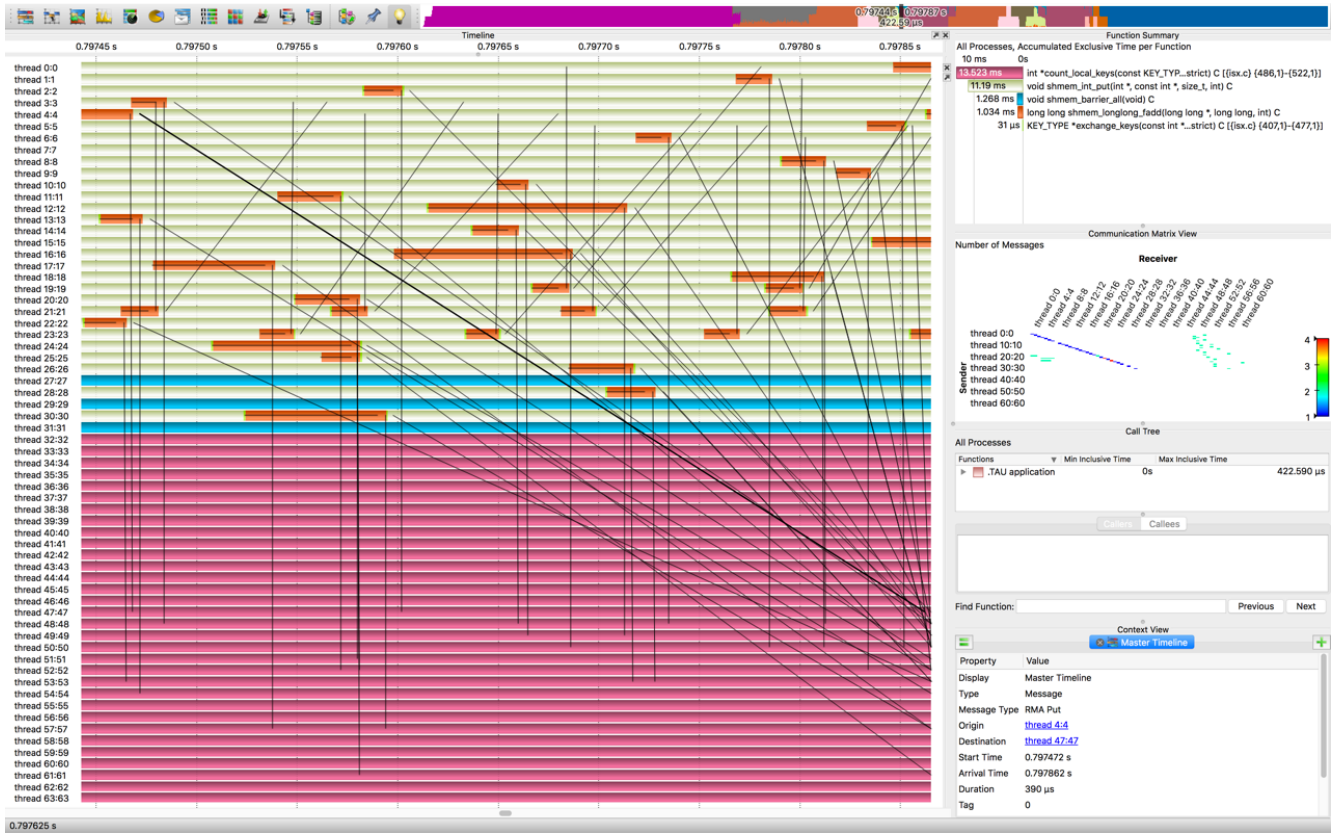
When do events occur?



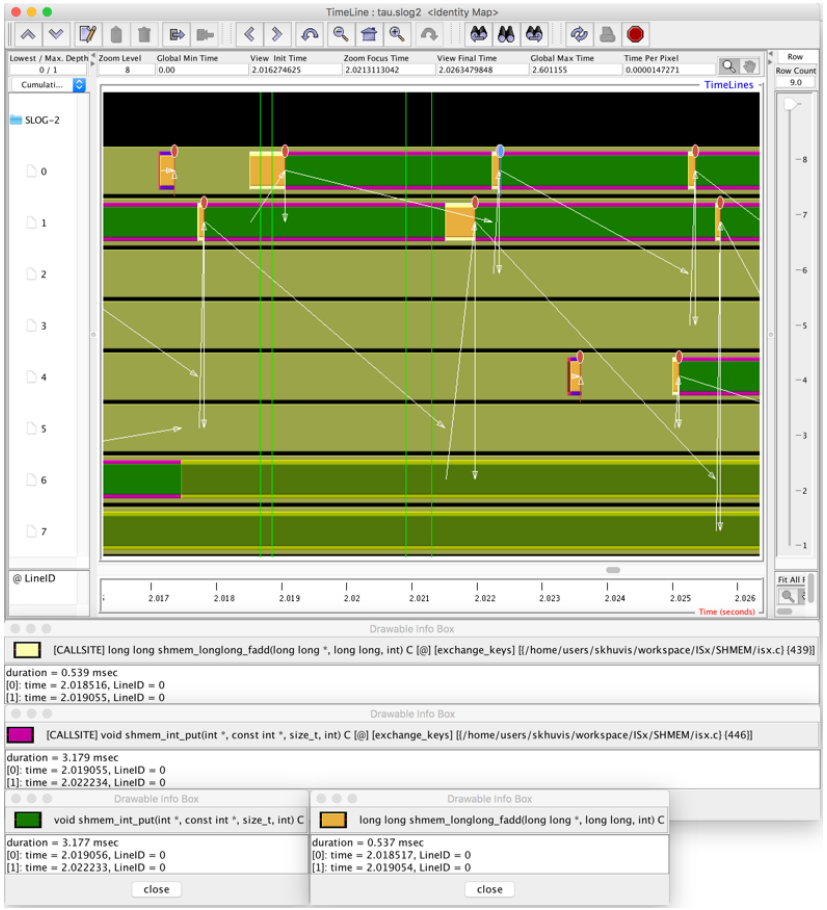
Different Nodes, Different Timelines



Zoom In to View Individual Communication API Calls



Where do Events Occur?



- Callsites differentiate calls to common functions
- Separate time spent in API routines that are called throughout the code.

What Caused My Application to Crash?

TAU: ParaProf Manager

ptions Help

:ations
andard Applications
Default App
Default Exp
py-c++-f90-create.ppk
TIME

TrialField	Value
Name	py-c++-f90-create.ppk
Application ID	0
Experiment ID	0
Trial ID	0
BACKTRACE 1	[SAMINT::timestep(double, double)] [/mnt/home/jlinford/py-c++-f90-create/SAMINT.C:77] [/mnt/home/jlinford/py-c++-f90-create/_samint.so]
BACKTRACE 2	[samarcStep(double, double)] [/mnt/home/jlinford/py-c++-f90-create/pycintfc.C:57] [/mnt/home/jlinford/py-c++-f90-create/_samint.so]
BACKTRACE 3	[_wrap_samarcStep] [/mnt/home/jlinford/py-c++-f90-create/samint_wrap.c:3883] [/mnt/home/jlinford/py-c++-f90-create/_samint.so]
BACKTRACE 4	[call_function] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:4013] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.sc
BACKTRACE 5	[fast_function] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:4099] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.sc
BACKTRACE 6	[PyEval_EvalCodeEx] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:3253] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpythor
BACKTRACE 7	[PyEval_EvalCode] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:667] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7
BACKTRACE 8	[PyImport_ExecCodeModuleEx] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/import.c:681] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/li
BACKTRACE 9	[load_source_module] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/import.c:1021] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpyt
BACKTRACE 10	[import_submodule] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/import.c:2596] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpyth
BACKTRACE 11	[load_next] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/import.c:2416] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so.
BACKTRACE 12	[import_module_level] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/import.c:2137] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpy
BACKTRACE 13	[builtin___import__] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/bltinmodule.c:49] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpyt
BACKTRACE 14	[PyObject_Call] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Objects/abstract.c:2529] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2
BACKTRACE 15	[PyEval_CallObjectWithKeywords] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:3882] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/
BACKTRACE 16	[PyEval_EvalFrameEx] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:2333] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpyth
BACKTRACE 17	[fast_function] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:4099] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.sc
BACKTRACE 18	[PyEval_EvalCodeEx] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:3253] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpythor
BACKTRACE 19	[PyEval_EvalCode] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:667] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7
BACKTRACE 20	[run_mod] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/pythonrun.c:1346] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.
BACKTRACE 21	[exec_statement] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:4746] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7
BACKTRACE 22	[PyEval_EvalCodeEx] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:3253] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpythor
BACKTRACE 23	[fast_function] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:4109] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.sc
BACKTRACE 24	[fast_function] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:4099] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.sc
BACKTRACE 25	[PyEval_EvalCodeEx] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:3253] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpythor

Argonne NATIONAL LABORATORY

ECP EXASCALE COMPUTING PROJECT

What Caused My Application to Crash?

Right-click to see source code

Metadata fo ,0,0

Show Source Code

Name	Value
BACKTRACE 1	[SAMINT::timestep(double, double)] [/mnt/home/jlinford/py-c++-f90-create/SAMI linford/py-c++-f90-create/_samint.so]
BACKTRACE 2	[samarcStep(double, double)] [/mnt/home/jlinford/py-c++-f90-create/pycintfc.C: /py-c++-f90-create/_samint.so]
BACKTRACE 3	[_wrap_samarcStep] [/mnt/home/jlinford/py-c++-f90-create/samint_wrap.c:3883] [/mnt/home/jlinford/py-c++-f90-create/_samint.so]
BACKTRACE 4	[call_function] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:4013] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so.1.0]
BACKTRACE 5	[fast_function] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:4099] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so.1.0]
BACKTRACE 6	[PyEval_EvalCodeEx] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:3253] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2....
BACKTRACE 7	[PyEval_EvalCode] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:667] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so...
BACKTRACE 8	[PyImport_ExecCodeModuleEx] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/import.c:681] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/li...
BACKTRACE 9	[load_source_module] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/import.c:1021] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython...
BACKTRACE 10	[import_submodule] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/import.c:2596] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2...
BACKTRACE 11	[load_next] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/import.c:2416] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so.1.0]
BACKTRACE 12	[import_module_level] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/import.c:2137] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpytho...
BACKTRACE 13	[builtin___import__] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/bltinmodule.c:49] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython...
BACKTRACE 14	[PyObject_Call] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Objects/abstract.c:2529] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7....
BACKTRACE 15	[PyEval_CallObjectWithKeywords] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:3882] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib...
BACKTRACE 16	[PyEval_EvalFrameEx] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:2333] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2....
BACKTRACE 17	[fast_function] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:4099] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so.1.0]
BACKTRACE 18	[PyEval_EvalCodeEx] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:3253] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2....
BACKTRACE 19	[PyEval_EvalCode] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:667] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so...
BACKTRACE 20	[run_mod] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/pythonrun.c:1346] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so....
BACKTRACE 21	[exec_statement] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:4746] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so...
BACKTRACE 22	[PyEval_EvalCodeEx] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:3253] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2....
BACKTRACE 23	[fast_function] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:4109] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so.1.0]
BACKTRACE 24	[fast_function] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:4099] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so.1.0]
BACKTRACE 25	[PyEval_EvalCodeEx] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:3253] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2....
BACKTRACE 26	[fast_function] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:4109] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so.1.0]
BACKTRACE 27	[PyEval_EvalCodeEx] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:3253] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2....
BACKTRACE 28	[PyEval_EvalCode] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/ceval.c:667] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so...
BACKTRACE 29	[run_mod] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/pythonrun.c:1346] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so....
BACKTRACE 30	[PyRun_SimpleFileExFlags] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Python/pythonrun.c:936] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/lib...
BACKTRACE 31	[Py_Main] [/mnt/home/jlinford/0.55/build/Python-2.7.2/Modules/main.c:599] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/Python-2.7.2/lib/libpython2.7.so.1.0]
BACKTRACE 32	[pyMPI_Main_with_communicator] [(unknown):0] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/pyMPI-2.5b0/bin/pyMPI]
BACKTRACE 33	[main] [(unknown):0] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/pyMPI-2.5b0/bin/pyMPI]
BACKTRACE 34	[__libc_start_main] [(unknown):0] [/lib64/libc-2.5.so]
BACKTRACE 35	[_start] [(unknown):0] [/mnt/cfs/pkgs/PTOOLS/pkgs/ptoolsrte-0.55/packages/pyMPI-2.5b0/bin/pyMPI]

Argonne NATIONAL LABORATORY

ECP EXASCALE COMPUTING PROJECT

What Caused My Application to Crash?

TAU: ParaProf: Source Browser: /mnt/home/jlinford/py-c++-f90-create/SAMINT.C

File Help

```
65  /*
66  ************************************************************************
67  *
68  * Take a timestep - advance solution from "time" to "time + dt"
69  *
70  ************************************************************************
71  */
72  void SAMINT::timestep(const double time,
73                        const double dt)
74  {
75     cout << "SAMINT::timestep()" << endl;
76     timestep_(time,dt);
77     int  x = 4 / (4-4);
78     cout <<" x = "<<x<<endl;
79
80  }
81
82  /*
83  ************************************************************************
84  *
85  * Write data to output
86  * (visit, fieldview, or overgrid - set in samarc input file)
87  *
88  ************************************************************************
89  */
90  void SAMINT::writePlotData(const double time,
91                             const int step)
92  {
93     cout << "SAMINT::writePlotData()" << endl;
```

Error Highlighted in Source Browser

Argonne NATIONAL LABORATORY

ECP EXASCALE COMPUTING PROJECT

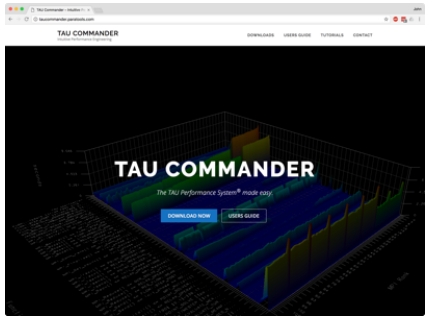
Conclusion

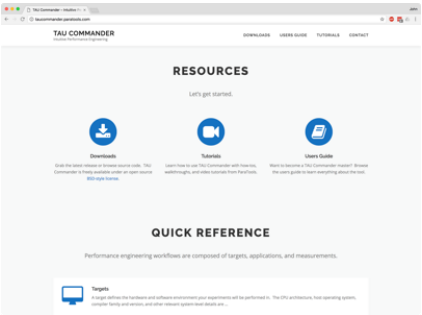
Downloads

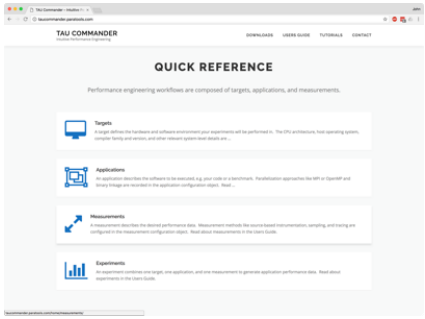
www.taucommander.com

www.github.com/ParaToolsInc/taucmdr

Free, open source, BSD license







Acknowledgements

- Engility
- HPCMP DoD PETTT Program
- Department of Energy
  - Office of Science
  - Argonne National Laboratory
  - Oak Ridge National Laboratory
  - NNSA/ASC Trilabs (SNL, LLNL, LANL)
- National Science Foundation
- University of Tennessee
- University of New Hampshire
- University of Oregon
- TU Dresden
- Research Centre Jülich