Automatic trace analysis with Scalasca

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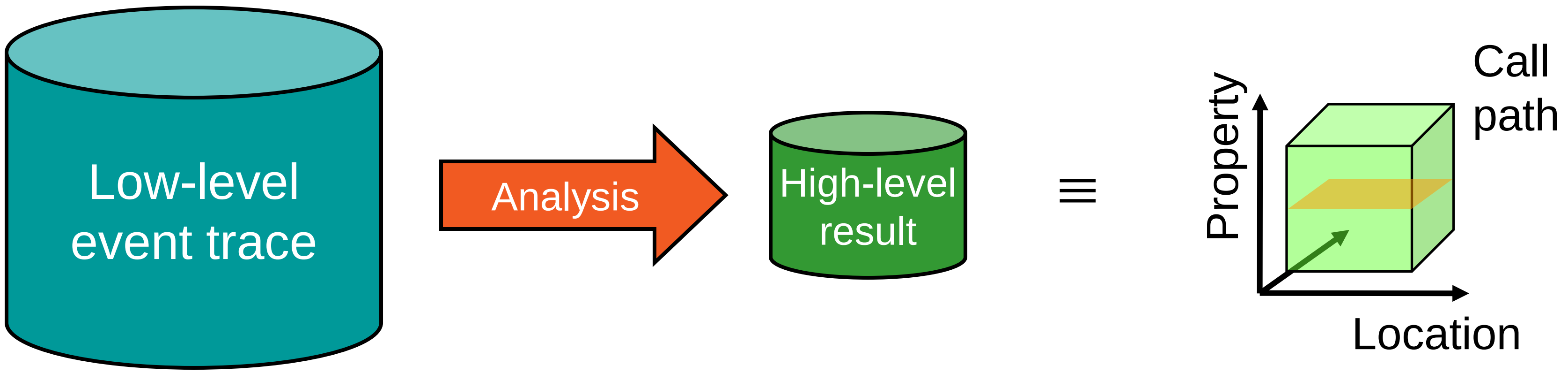
Automatic trace analysis

- Idea
  - Automatic search for patterns of inefficient behavior
  - Classification of behavior & quantification of significance



  - Guaranteed to cover the entire event trace
  - Quicker than manual/visual trace analysis
  - Parallel replay analysis exploits available memory & processors to deliver scalability

The Scalasca project: Overview

- Project started in 2006
  - Initial funding by Helmholtz Initiative & Networking Fund
  - Many follow-up projects
- Follow-up to pioneering KOJAK project (started 1998)
  - Automatic pattern-based trace analysis
- Now joint development of
  - Jülich Supercomputing Centre
  - German Research School for Simulation Sciences

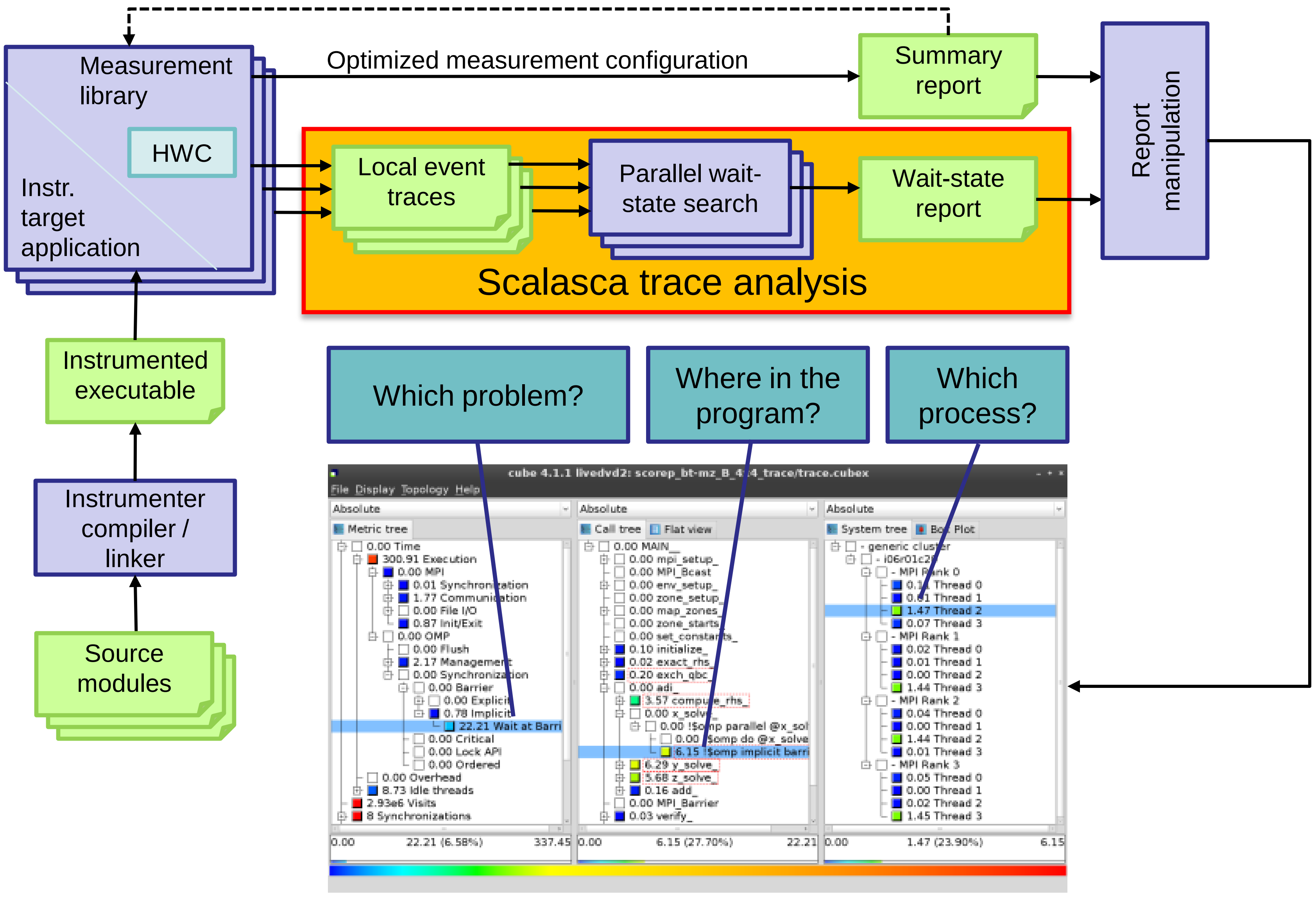
The Scalasca project: Objective

- Development of a **scalable** performance analysis toolset for most popular parallel programming paradigms
- Specifically targeting **large-scale** parallel applications
  - such as those running on IBM BlueGene or Cray XT systems with one million or more processes/threads
- Latest release:
  - Scalasca v2.0 with Score-P support (August 2013)

Scalasca 2.0 features

- Open source, New BSD license
- Fairly portable
  - IBM Blue Gene, IBM SP & blade clusters, Cray XT, SGI Altix, Solaris & Linux clusters, ...
- Uses Score-P instrumenter & measurement libraries
  - Scalasca 2.0 core package focuses on trace-based analyses
  - Supports common data formats
    - Reads event traces in OTF2 format
    - Writes analysis reports in CUBE4 format
- Current limitations:
  - No support for nested OpenMP parallelism and tasking
  - Unable to handle OTF2 traces containing CUDA events

Scalasca workflow



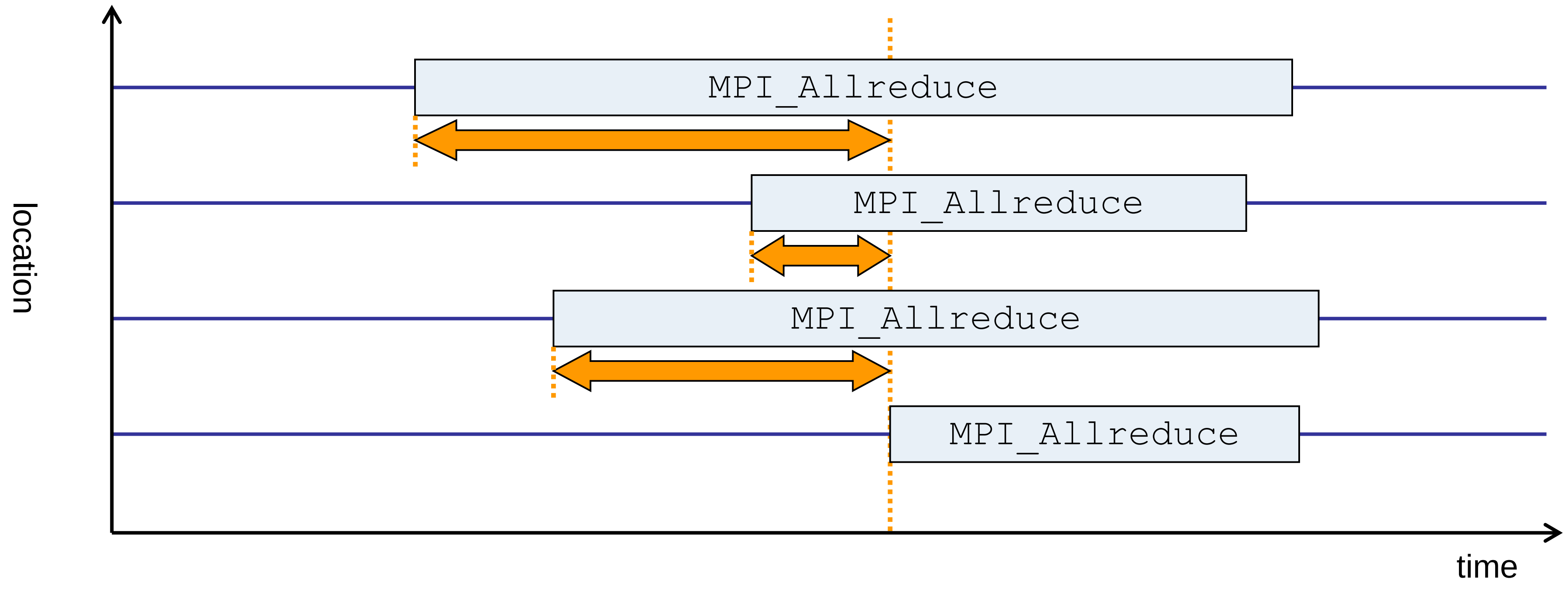
```
cube 4.1.1 livedvd2: scorep_bt-mz_B_4x4_trace/trace.cubex
File  Display  Topology  Help
```

```
Absolute
Metric tree
0.00 Time
  300.91 Execution
    0.00 MPI
      0.01 Synchronization
      1.77 Communication
      0.00 File I/O
      0.87 Init/Exit
    0.00 OMP
      0.00 Flush
      2.17 Management
      0.00 Synchronization
        0.00 Barrier
          0.00 Explicit
          0.78 Implicit
            22.21 Wait at Barri
        0.00 Critical
        0.00 Lock API
        0.00 Ordered
  0.00 Overhead
  8.73 Idle threads
2.93e6 Visits
8 Synchronizations
0.00            22.21 (6.58%)           337.45
```

```
Absolute
Call tree   Flat view
0.00 MAIN__
  0.00 mpi_setup_
  0.00 MPI_Bcast
  0.00 env_setup_
  0.00 zone_setup_
  0.00 map_zones_
  0.00 zone_starts_
  0.00 set_constants_
  0.10 initialize_
  0.02 exact_rhs_
  0.20 exch_qbc_
  0.00 adi_
    3.57 compute_rhs_
    0.00 x_solve_
      0.00 !$omp parallel @x_sol
        0.00 !$omp do @x_solve
        6.15 !$omp implicit barri
    6.29 y_solve_
    5.68 z_solve_
    0.16 add_
  0.00 MPI_Barrier
  0.03 verify_
0.00            6.15 (27.70%)           22.21
```

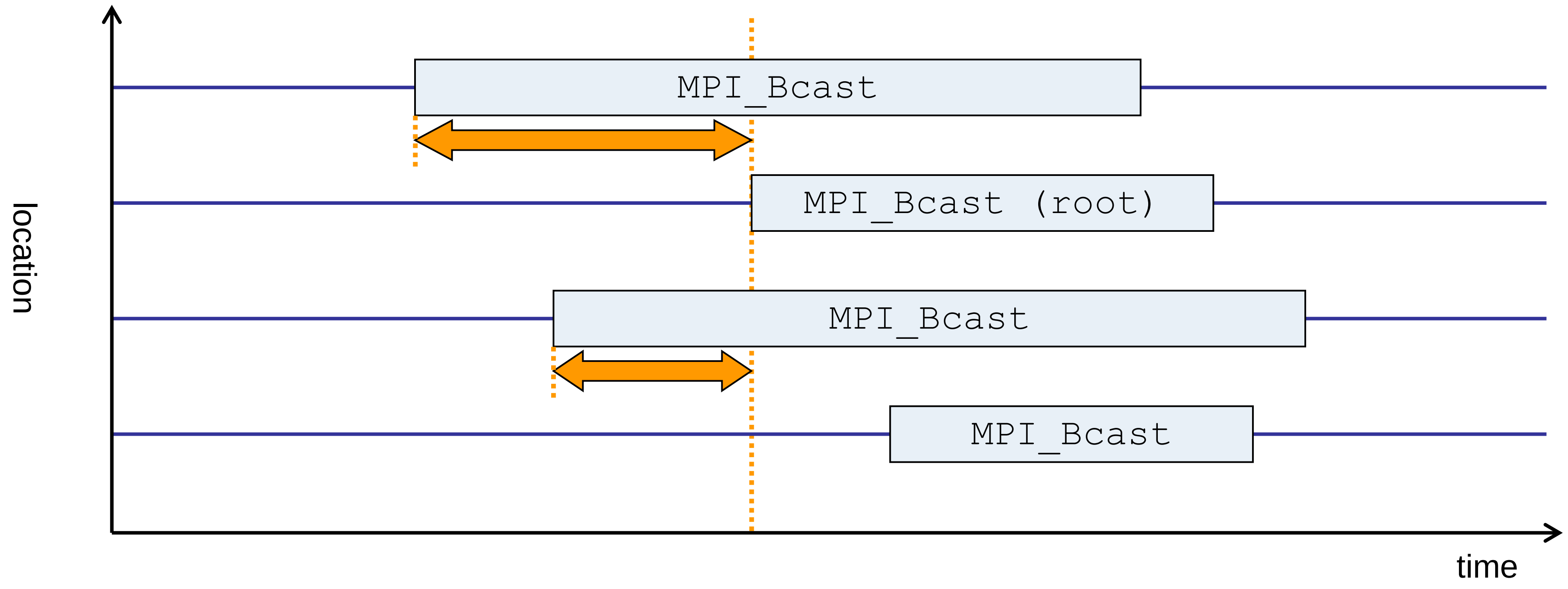
```
Absolute
System tree   Box Plot
- generic cluster
  - i06r01c28
    - MPI Rank 0
      0.11 Thread 0
      0.01 Thread 1
      1.47 Thread 2
      0.07 Thread 3
    - MPI Rank 1
      0.02 Thread 0
      0.01 Thread 1
      0.00 Thread 2
      1.44 Thread 3
    - MPI Rank 2
      0.04 Thread 0
      0.00 Thread 1
      1.44 Thread 2
      0.01 Thread 3
    - MPI Rank 3
      0.05 Thread 0
      0.00 Thread 1
      0.02 Thread 2
      1.45 Thread 3
0.00            1.47 (23.90%)           6.15
```

Example: Wait at NxN



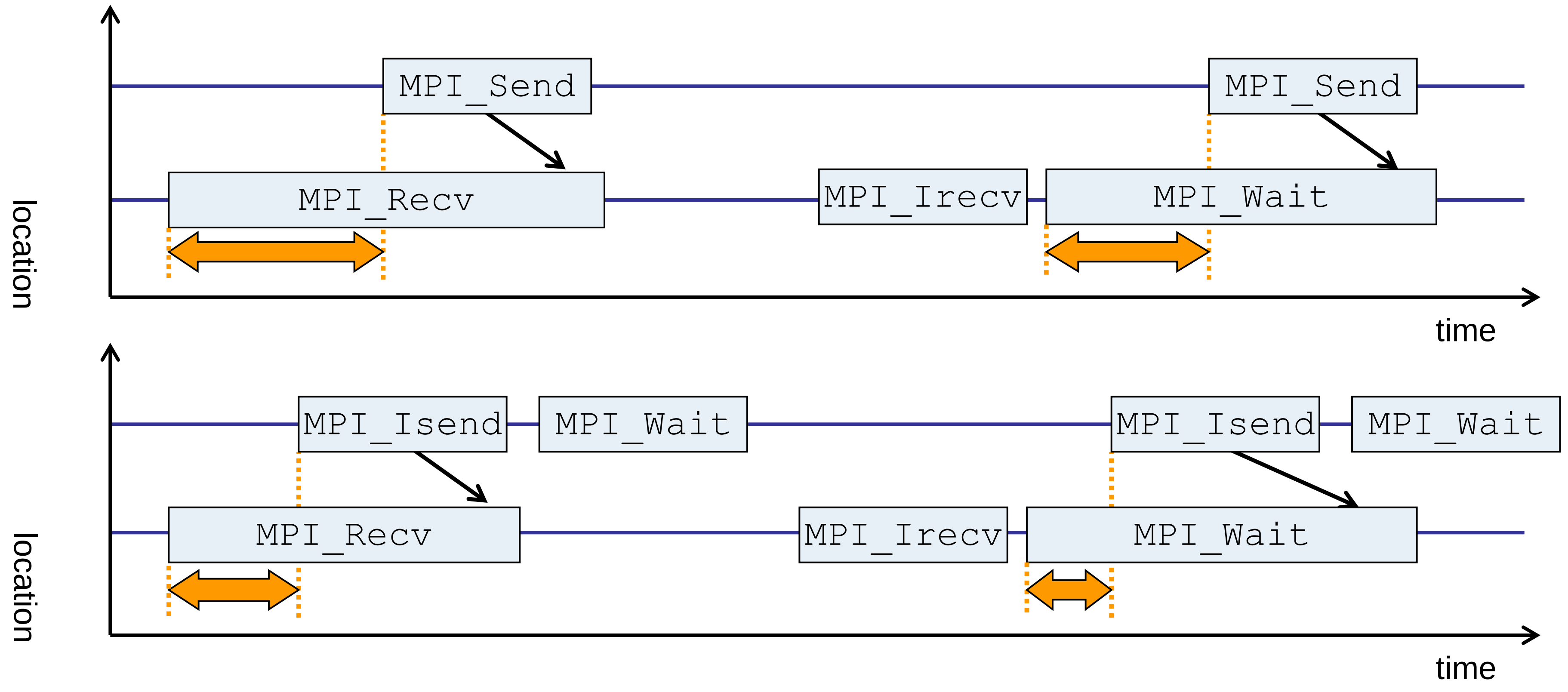
- Time spent waiting in front of synchronizing collective operation until the last process reaches the operation
- Applies to: MPI_Allgather, MPI_Allgatherv, MPI_Alltoall, MPI_Reduce_scatter, MPI_Reduce_scatter_block, MPI_Allreduce

Example: Late Broadcast



- Waiting times if the destination processes of a collective 1-to-N operation enter the operation earlier than the source process (root)
- Applies to: MPI_Bcast, MPI_Scatter, MPI_Scatterv

Example: Late Sender



- Waiting time caused by a blocking receive operation posted earlier than the corresponding send
- Applies to blocking as well as non-blocking communication

Hands-on: NPB-MZ-MPI / BT

scalasca

Scalasca command

- One command for (almost) everything…

```
% scalasca
Scalasca 2.1-alpha2
Toolset for scalable performance analysis of large-scale parallel applications
usage: scalasca [-v][-n] {action}
    1. prepare application objects and executable for measurement:
       scalasca -instrument <compile-or-link-command> # skin (using scorep)
    2. run application under control of measurement system:
       scalasca -analyze <application-launch-command> # scan
    3. interactively explore measurement analysis report:
       scalasca -examine <experiment-archive|report>  # square

   -v, --verbose      enable verbose commentary
   -n, --dry-run      show actions without taking them
   -c, --show-config  show configuration and exit
```

  – The ‘`scalasca -instrument`’ command is deprecated and only provided for backwards compatibility with Scalasca 1.x.
  – Recommended: use Score-P instrumenter directly

Scalasca compatibility command: *skin*

- Scalasca application instrumenter

```
% skin
Scalasca 2.1-alpha2: application instrumenter (using <PATH_TO_SCOREP>/scorep)
usage: skin [-v] [-comp] [-pdt] [-pomp] [-user] [--*] <compile-or-link-command>
  -comp={all|none|...}: routines to be instrumented by compiler [default: all]
                 (... custom instrumentation specification depends on compiler)
  -pdt:  process source files with PDT/TAU instrumenter
  -pomp: process source files for POMP directives
  -user: enable EPIK user instrumentation API macros in source code
  -v:    enable verbose commentary when instrumenting

  --*:   options to pass to <PATH_TO_SCOREP>/scorep
```

  – Provides compatibility with Scalasca 1.x
  – Recommended: use Score-P instrumenter directly

Scalasca convenience command: *scan*

- Scalasca measurement collection & analysis nexus

```
% scan
Scalasca 2.1-alpha2: measurement collection & analysis nexus
usage: scan {options} [launchcmd [launchargs]] target [targetargs]
      where {options} may include:
  -h    Help: show this brief usage message and exit.
  -v    Verbose: increase verbosity.
  -n    Preview: show command(s) to be launched but don't execute.
  -q    Quiescent: execution with neither summarization nor tracing.
  -s    Summary: enable runtime summarization. [Default]
  -t    Tracing: enable trace collection and analysis.
  -a    Analyze: skip measurement to (re-)analyze an existing trace.
  -e exptdir   : Experiment archive to generate and/or analyze.
                 (overrides default experiment archive title)
  -f filtfile  : File specifying measurement filter.
  -l lockfile  : File that blocks start of measurement.
  -m metrics   : Metric specification for measurement.
```

Scalasca convenience command: *square*

- Scalasca analysis report explorer

```
% square
Scalasca 2.1-alpha2: analysis report explorer
usage: square [-v] [-s] [-f filtfile] [-F] <experiment archive | cube file>
   -F           : Force remapping of already existing reports
   -f filtfile : Use specified filter file when doing scoring
   -s           : Skip display and output textual score report
   -v           : Enable verbose mode
```

Automatic measurement configuration

- **`scan`** configures Score-P measurement by setting some environment variables automatically
  - e.g., experiment title, profiling/tracing mode, filter file, …
  - Precedence order:
    - Command-line arguments
    - Environment variables already set
    - Automatically determined values
- Also, **`scan`** includes consistency checks and prevents corrupting existing experiment directories
- For tracing experiments, after trace collection completes then automatic parallel trace analysis is initiated
  - uses identical launch configuration to that used for measurement (i.e., the same allocated compute resources)

BT-MZ summary measurement

- Run the application using the Scalasca measurement collection & analysis nexus prefixed to launch command

```
% export SCOREP_EXPERIMENT_DIRECTORY=scorep_bt-mz_B_4p4x4_sum
% OMP_NUM_THREADS=4 scan mpirun -np 4 -npernode 4./bt-mz_B.4
S=C=A=N: Fri Jan 31 12:50:12 2014: Collect start
/apps/OPENMPI/1.5.4//bin/mpirun -n 4 -npernode 4 ./bt-mz_B.4

 NAS Parallel Benchmarks (NPB3.3-MZ-MPI) - BT-MZ MPI+OpenMP Benchmark

 Number of zones:    8 x    8
 Iterations: 200     dt:    0.000300
 Number of active processes:      4

 Use the default load factors with threads
 Total number of threads:      16  (   4.0 threads/process)

 [... More application output ...]
S=C=A=N: Fri Jan 31 12:51:04 2014: Collect done (status=0) 52s
```

- Creates experiment directory ./scorep_bt-mz_B_4p4x4_sum

BT-MZ summary analysis report examination

- Score summary analysis report

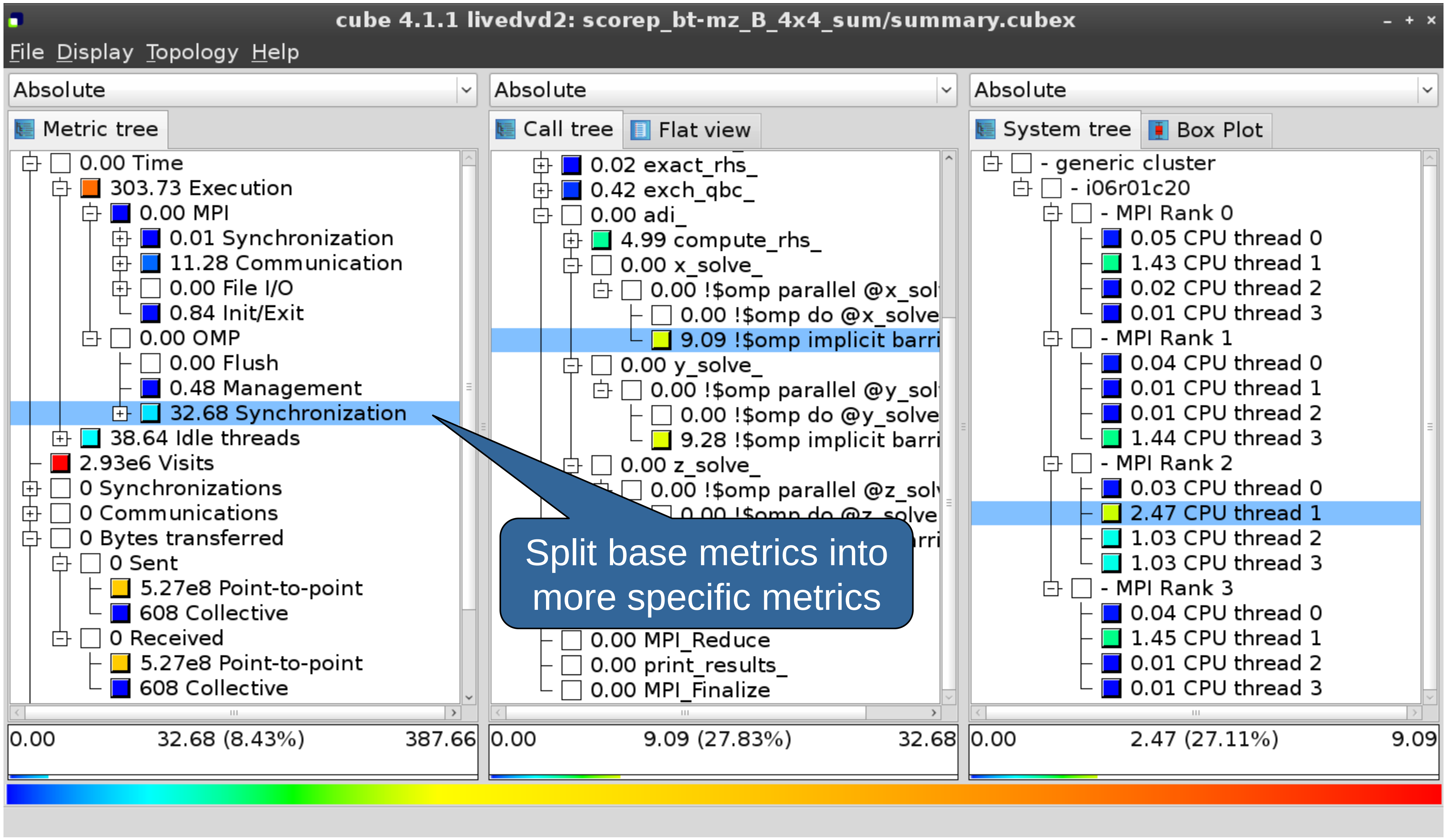
```
% square -s  scorep_bt-mz_B_4p4x4_sum
INFO: Post-processing runtime summarization report...
<PATH>/scorep-score -r ./scorep_bt-mz_B_4p4x4_sum/profile.cubex >
  ./scorep_bt-mz_B_4p4x4_sum/scorep.score
INFO: Score report written to ./scorep_bt-mz_B_4p4x4_sum/scorep.score
```

- Post-processing and interactive exploration with CUBE

```
% square  scorep_bt-mz_B_4p4x4_sum
INFO: Displaying ./scorep_bt-mz_B_4p4x4_sum/summary.cubex...

                  [GUI showing summary analysis report]
```

- The post-processing derives additional metrics and generates a structured metric hierarchy

Post-processed summary analysis report



cube 4.1.1 livedvd2: scorep_bt-mz_B_4x4_sum/summary.cubex

File Display Topology Help

```
Absolute                          Absolute                              Absolute
Metric tree                       Call tree | Flat view                 System tree | Box Plot

0.00 Time                             0.02 exact_rhs_                   - generic cluster
  303.73 Execution                    0.42 exch_qbc_                      - i06r01c20
    0.00 MPI                          0.00 adi_                             - MPI Rank 0
      0.01 Synchronization              4.99 compute_rhs_                     0.05 CPU thread 0
      11.28 Communication               0.00 x_solve_                         1.43 CPU thread 1
      0.00 File I/O                       0.00 !$omp parallel @x_sol          0.02 CPU thread 2
      0.84 Init/Exit                        0.00 !$omp do @x_solve            0.01 CPU thread 3
    0.00 OMP                                9.09 !$omp implicit barri       - MPI Rank 1
      0.00 Flush                        0.00 y_solve_                         0.04 CPU thread 0
      0.48 Management                     0.00 !$omp parallel @y_sol          0.01 CPU thread 1
      32.68 Synchronization                 0.00 !$omp do @y_solve            0.01 CPU thread 2
  38.64 Idle threads                        9.28 !$omp implicit barri         1.44 CPU thread 3
2.93e6 Visits                           0.00 z_solve_                       - MPI Rank 2
0 Synchronizations                        0.00 !$omp parallel @z_solv         0.03 CPU thread 0
0 Communications                            0.00 !$omp do @z_solve            2.47 CPU thread 1
0 Bytes transferred                         rri                               1.03 CPU thread 2
  0 Sent                                                                      1.03 CPU thread 3
    5.27e8 Point-to-point                                                   - MPI Rank 3
    608 Collective                                                            0.04 CPU thread 0
  0 Received                          0.00 MPI_Reduce                         1.45 CPU thread 1
    5.27e8 Point-to-point             0.00 print_results_                     0.01 CPU thread 2
    608 Collective                    0.00 MPI_Finalize                       0.01 CPU thread 3

0.00    32.68 (8.43%)    387.66   0.00    9.09 (27.83%)    32.68   0.00    2.47 (27.11%)    9.09
```

Split base metrics into more specific metrics

Performance Analysis Steps

0.0 Reference preparation for validation

1.0 Program instrumentation

1.1 Summary measurement collection

1.2 Summary analysis report examination

2.0 Summary experiment scoring

2.1 Summary measurement collection with filtering

2.2 Filtered summary analysis report examination

3.0 Event trace collection

3.1 Event trace examination & analysis

Setup environment

- Load modules

```
% module use /gpfs/projects/nct00/nct00001/UNITE/tutorial/mf
% module load UNITE
UNITE loaded
% module load scalasca
cube4/4.2.1 loaded
papi/5.3.0 loaded
scorep/1.2.3-beta-intel-openmpi loaded
scalasca/2.1-alpha2-intel-openmpi loaded
```

- Change to directory containing NPB BT-MZ sources
- Existing instrumented binary in bin.scorep/ can be reused

BT-MZ trace measurement collection...

- Change to executable directory and edit job script

```
% cd bin.scorep
% cp ../jobscript/marenostrum3/scalasca2.lsf .
% vim scalasca2.lsf

  [...]

module load UNITE scalasca/2.1-alpha1

export SCOREP_FILTERING_FILE=../config/scorep.filt
export SCOREP_TOTAL_MEMORY=50M
export SCOREP_METRIC_PAPI=PAPI_FP_OPS
export OMP_NUM_THREADS=4

scalasca -analyze -t mpirun -n 4 -npernode 4 ./bt-mz_B.4
```

- Submit the job

```
% bsub < scalasca2.lsf
```

BT-MZ trace measurement ... analysis

- Continues with automatic (parallel) analysis of trace files

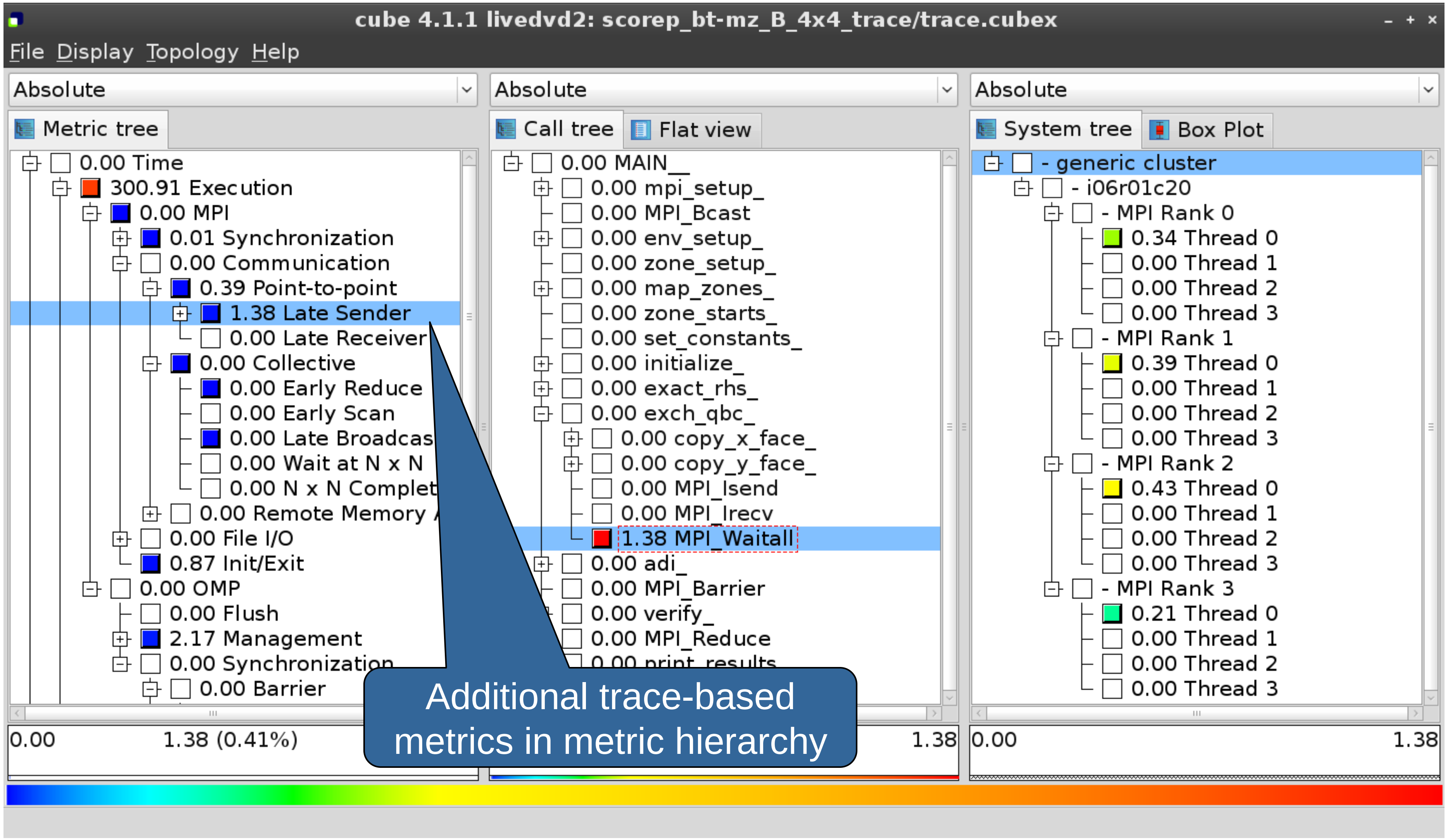
```
S=C=A=N: Fri Sep 20 15:09:59 2013: Analyze start

Analyzing experiment archive ./scorep_bt-mz_B_4p4x4_trace/traces.otf2

Opening experiment archive ... done (0.044s).
Reading definition data    ... done (0.007s).
Reading event trace data   ... done (0.593s).
Preprocessing              ... done (1.100s).
Analyzing trace data       ...
  Wait-state detection (fwd)      (1/5) ... done (2.464s).
  Wait-state detection (bwd)      (2/5) ... done (0.052s).
  Synchpoint exchange             (3/5) ... done (0.198s).
  Critical-path & delay analysis  (4/5) ... done (0.306s).
done (3.188s).
Writing analysis report    ... done (0.228s).

Max. memory usage         : 167.840MB

Total processing time     : 5.651s
S=C=A=N: Fri Jan 31 13:09:04 2014: Analyze done (status=0) 7s
```

BT-MZ trace analysis report exploration

- Produces trace analysis report in experiment directory containing trace-based wait-state metrics

```
% square  scorep_bt-mz_B_4p4x4_trace
INFO: Post-processing runtime summarization report...
INFO: Post-processing trace analysis report...
INFO: Displaying ./scorep_bt-mz_B_4p4x4_trace/trace.cubex...

                 [GUI showing trace analysis report]
```

Post-processed trace analysis report



cube 4.1.1 livedvd2: scorep_bt-mz_B_4x4_trace/trace.cubex

File Display Topology Help

Absolute | Absolute | Absolute

Metric tree:

```
0.00 Time
  300.91 Execution
    0.00 MPI
      0.01 Synchronization
      0.00 Communication
        0.39 Point-to-point
          1.38 Late Sender
          0.00 Late Receiver
        0.00 Collective
          0.00 Early Reduce
          0.00 Early Scan
          0.00 Late Broadcas
          0.00 Wait at N x N
          0.00 N x N Complet
        0.00 Remote Memory
      0.00 File I/O
      0.87 Init/Exit
    0.00 OMP
      0.00 Flush
      2.17 Management
      0.00 Synchronization
        0.00 Barrier
```

Call tree / Flat view:

```
0.00 MAIN__
  0.00 mpi_setup_
  0.00 MPI_Bcast
  0.00 env_setup_
  0.00 zone_setup_
  0.00 map_zones_
  0.00 zone_starts_
  0.00 set_constants_
  0.00 initialize_
  0.00 exact_rhs_
  0.00 exch_qbc_
    0.00 copy_x_face_
    0.00 copy_y_face_
    0.00 MPI_Isend
    0.00 MPI_Irecv
    1.38 MPI_Waitall
  0.00 adi_
  0.00 MPI_Barrier
  0.00 verify_
  0.00 MPI_Reduce
  0.00 print_results
```

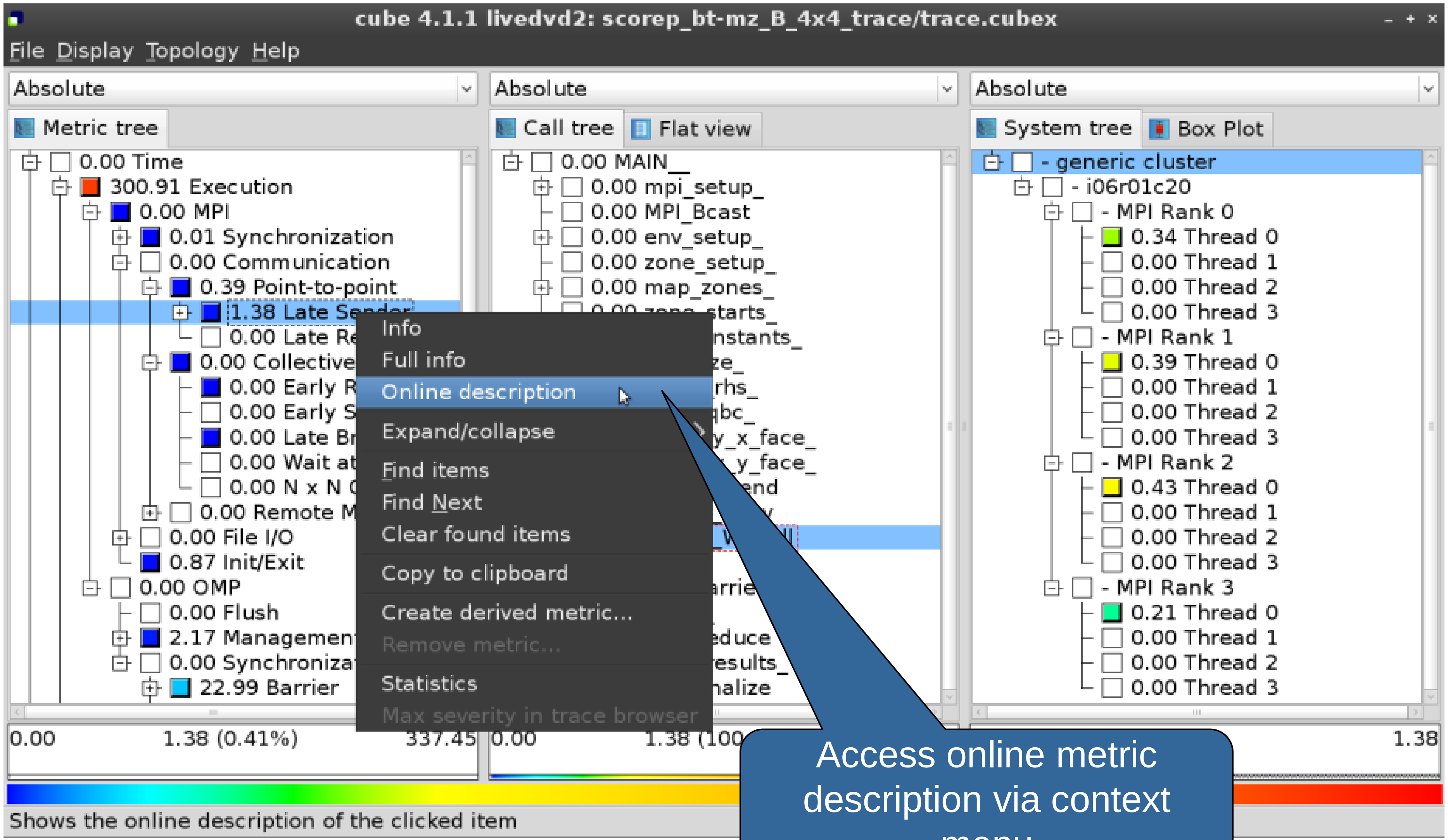
System tree / Box Plot:

```
- generic cluster
  - i06r01c20
    - MPI Rank 0
      0.34 Thread 0
      0.00 Thread 1
      0.00 Thread 2
      0.00 Thread 3
    - MPI Rank 1
      0.39 Thread 0
      0.00 Thread 1
      0.00 Thread 2
      0.00 Thread 3
    - MPI Rank 2
      0.43 Thread 0
      0.00 Thread 1
      0.00 Thread 2
      0.00 Thread 3
    - MPI Rank 3
      0.21 Thread 0
      0.00 Thread 1
      0.00 Thread 2
      0.00 Thread 3
```

0.00 1.38 (0.41%) | 1.38 | 0.00 1.38

Additional trace-based metrics in metric hierarchy

Online metric description



```
0.00 Time
  300.91 Execution
    0.00 MPI
      0.01 Synchronization
      0.00 Communication
        0.39 Point-to-point
          1.38 Late Sender
          0.00 Late Re
        0.00 Collective
          0.00 Early R
          0.00 Early S
          0.00 Late Br
          0.00 Wait at
          0.00 N x N C
        0.00 Remote M
      0.00 File I/O
      0.87 Init/Exit
    0.00 OMP
      0.00 Flush
      2.17 Managemen
      0.00 Synchroniza
        22.99 Barrier
```

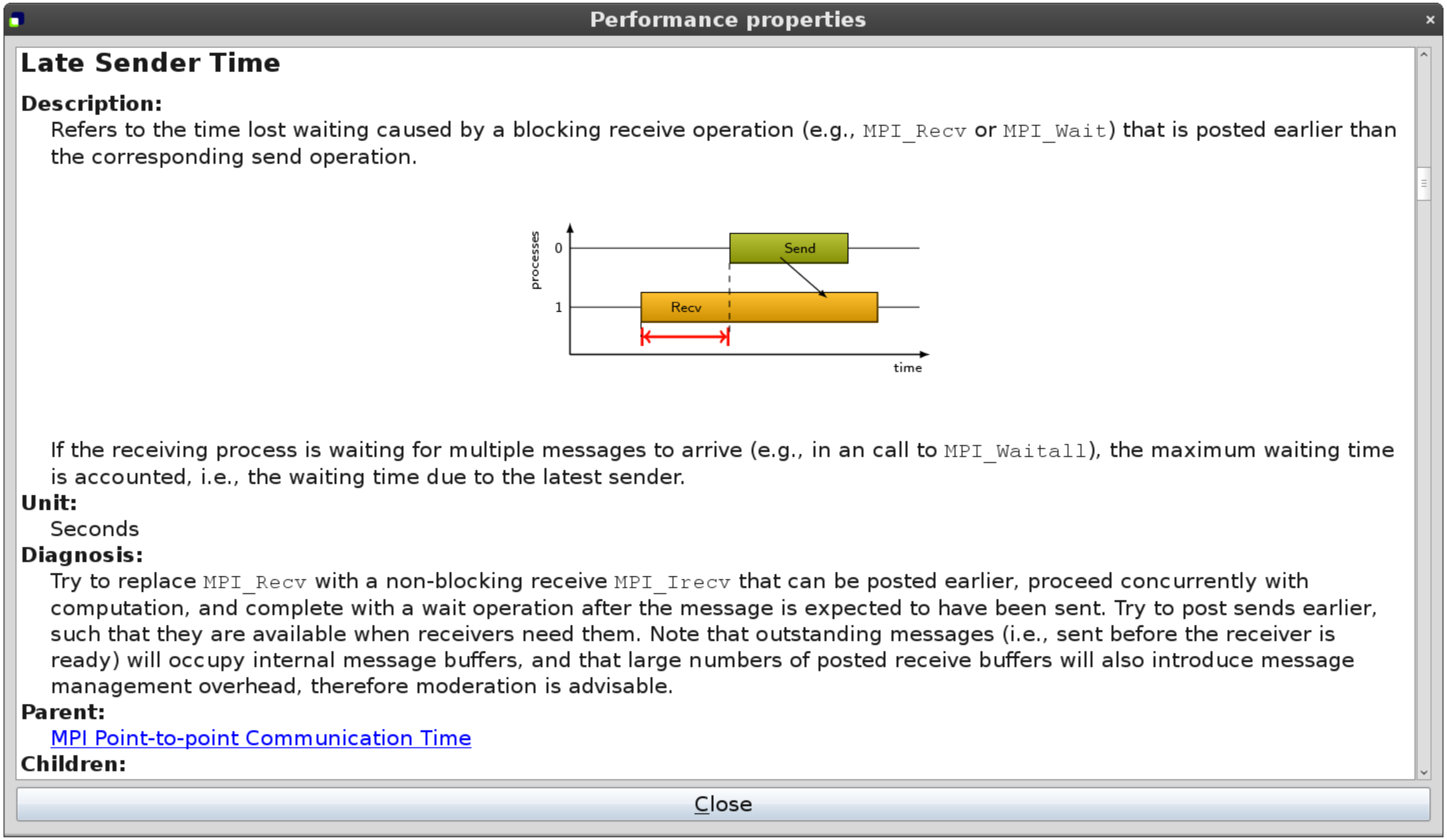
```
0.00 MAIN__
  0.00 mpi_setup_
  0.00 MPI_Bcast
  0.00 env_setup_
  0.00 zone_setup_
  0.00 map_zones_
```

```
- generic cluster
  - i06r01c20
    - MPI Rank 0
      0.34 Thread 0
      0.00 Thread 1
      0.00 Thread 2
      0.00 Thread 3
    - MPI Rank 1
      0.39 Thread 0
      0.00 Thread 1
      0.00 Thread 2
      0.00 Thread 3
    - MPI Rank 2
      0.43 Thread 0
      0.00 Thread 1
      0.00 Thread 2
      0.00 Thread 3
    - MPI Rank 3
      0.21 Thread 0
      0.00 Thread 1
      0.00 Thread 2
      0.00 Thread 3
```

0.00 1.38 (0.41%) 337.45 | 0.00 1.38 (100 | 1.38

Access online metric description via context menu

Online metric description

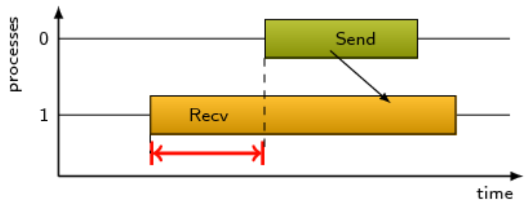


Performance properties

Late Sender Time

Description:

Refers to the time lost waiting caused by a blocking receive operation (e.g., `MPI_Recv` or `MPI_Wait`) that is posted earlier than the corresponding send operation.



If the receiving process is waiting for multiple messages to arrive (e.g., in an call to `MPI_Waitall`), the maximum waiting time is accounted, i.e., the waiting time due to the latest sender.

Unit:

Seconds

Diagnosis:

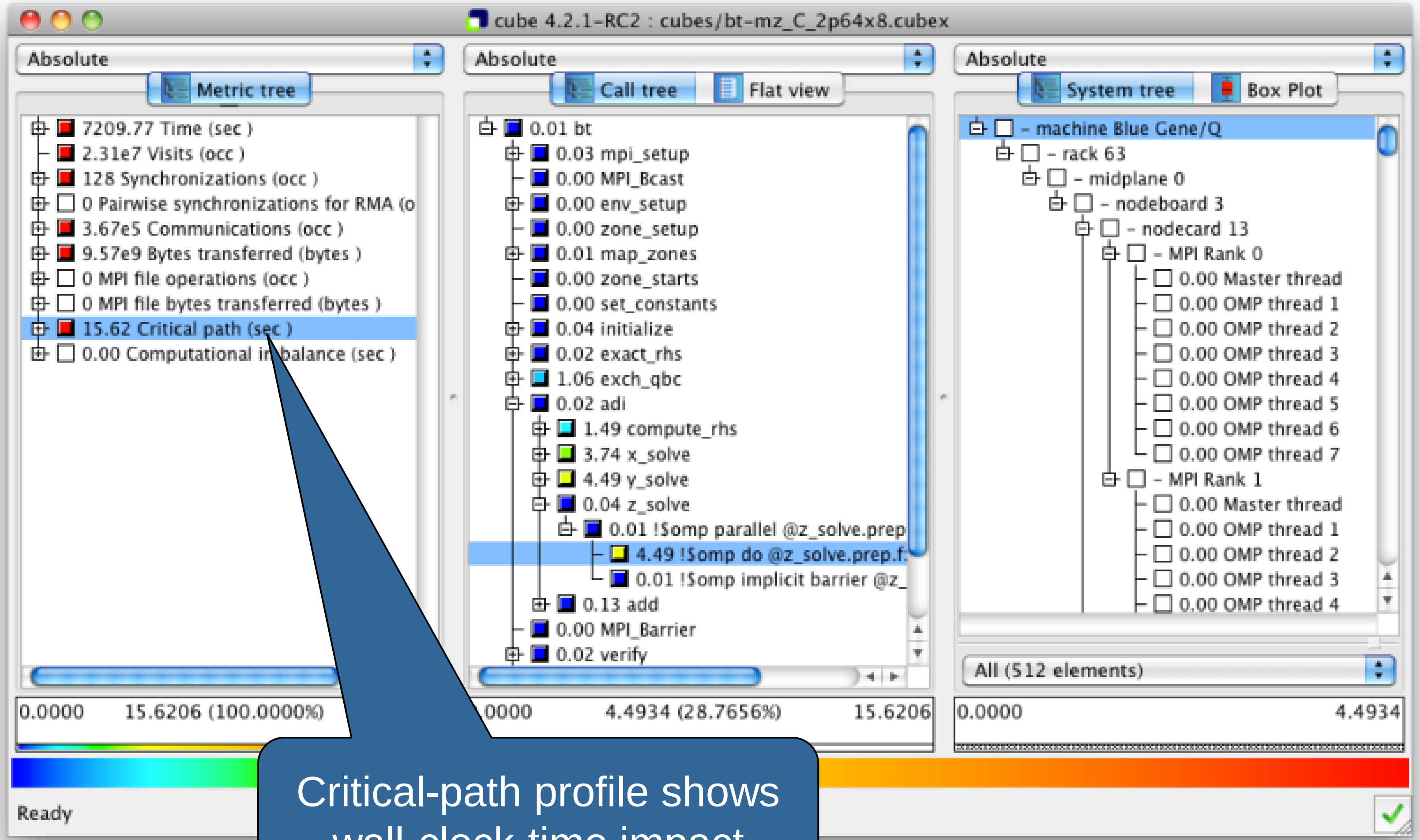
Try to replace `MPI_Recv` with a non-blocking receive `MPI_Irecv` that can be posted earlier, proceed concurrently with computation, and complete with a wait operation after the message is expected to have been sent. Try to post sends earlier, such that they are available when receivers need them. Note that outstanding messages (i.e., sent before the receiver is ready) will occupy internal message buffers, and that large numbers of posted receive buffers will also introduce message management overhead, therefore moderation is advisable.

Parent:

MPI Point-to-point Communication Time

Children:

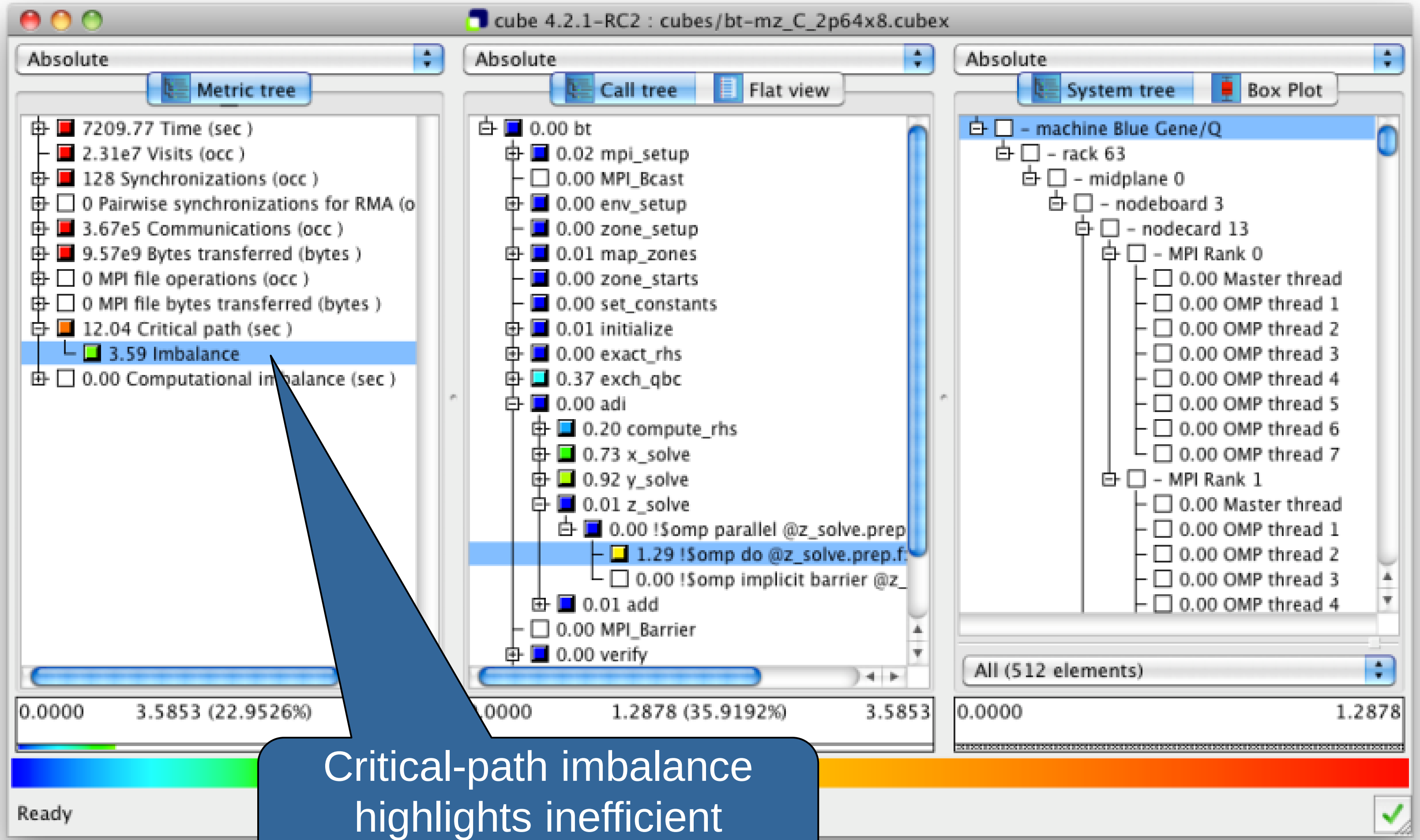
Critical-path analysis


cube 4.2.1-RC2 : cubes/bt-mz_C_2p64x8.cubex

```
Absolute                                   Absolute                                      Absolute
Metric tree                                Call tree | Flat view                         System tree | Box Plot

7209.77 Time (sec )                        0.01 bt                                       - machine Blue Gene/Q
2.31e7 Visits (occ )                         0.03 mpi_setup                                - rack 63
128 Synchronizations (occ )                  0.00 MPI_Bcast                                  - midplane 0
0 Pairwise synchronizations for RMA (o       0.00 env_setup                                    - nodeboard 3
3.67e5 Communications (occ )                 0.00 zone_setup                                     - nodecard 13
9.57e9 Bytes transferred (bytes )            0.01 map_zones                                        - MPI Rank 0
0 MPI file operations (occ )                 0.00 zone_starts                                        0.00 Master thread
0 MPI file bytes transferred (bytes )        0.00 set_constants                                      0.00 OMP thread 1
15.62 Critical path (sec )                   0.04 initialize                                         0.00 OMP thread 2
0.00 Computational imbalance (sec )          0.02 exact_rhs                                          0.00 OMP thread 3
                                             1.06 exch_qbc                                           0.00 OMP thread 4
                                             0.02 adi                                                0.00 OMP thread 5
                                               1.49 compute_rhs                                      0.00 OMP thread 6
                                               3.74 x_solve                                          0.00 OMP thread 7
                                               4.49 y_solve                                        - MPI Rank 1
                                               0.04 z_solve                                          0.00 Master thread
                                                 0.01 !$omp parallel @z_solve.prep                   0.00 OMP thread 1
                                                   4.49 !$omp do @z_solve.prep.f                     0.00 OMP thread 2
                                                   0.01 !$omp implicit barrier @z_                   0.00 OMP thread 3
                                               0.13 add                                              0.00 OMP thread 4
                                             0.00 MPI_Barrier
                                             0.02 verify                                                 All (512 elements)

0.0000     15.6206 (100.0000%)             .0000     4.4934 (28.7656%)     15.6206   0.0000                      4.4934

Ready
```

Critical-path profile shows wall-clock time impact

Critical-path analysis



cube 4.2.1-RC2 : cubes/bt-mz_C_2p64x8.cubex

Absolute | Absolute | Absolute

Metric tree | Call tree | Flat view | System tree | Box Plot

```
7209.77 Time (sec )
2.31e7 Visits (occ )
128 Synchronizations (occ )
0 Pairwise synchronizations for RMA (o
3.67e5 Communications (occ )
9.57e9 Bytes transferred (bytes )
0 MPI file operations (occ )
0 MPI file bytes transferred (bytes )
12.04 Critical path (sec )
  3.59 Imbalance
0.00 Computational imbalance (sec )
```

```
0.00 bt
  0.02 mpi_setup
  0.00 MPI_Bcast
  0.00 env_setup
  0.00 zone_setup
  0.01 map_zones
  0.00 zone_starts
  0.00 set_constants
  0.01 initialize
  0.00 exact_rhs
  0.37 exch_qbc
  0.00 adi
    0.20 compute_rhs
    0.73 x_solve
    0.92 y_solve
    0.01 z_solve
      0.00 !$omp parallel @z_solve.prep
        1.29 !$omp do @z_solve.prep.f
        0.00 !$omp implicit barrier @z_
    0.01 add
  0.00 MPI_Barrier
  0.00 verify
```

```
- machine Blue Gene/Q
  - rack 63
    - midplane 0
      - nodeboard 3
        - nodecard 13
          - MPI Rank 0
            0.00 Master thread
            0.00 OMP thread 1
            0.00 OMP thread 2
            0.00 OMP thread 3
            0.00 OMP thread 4
            0.00 OMP thread 5
            0.00 OMP thread 6
            0.00 OMP thread 7
          - MPI Rank 1
            0.00 Master thread
            0.00 OMP thread 1
            0.00 OMP thread 2
            0.00 OMP thread 3
            0.00 OMP thread 4
```

All (512 elements)

0.0000 3.5853 (22.9526%)

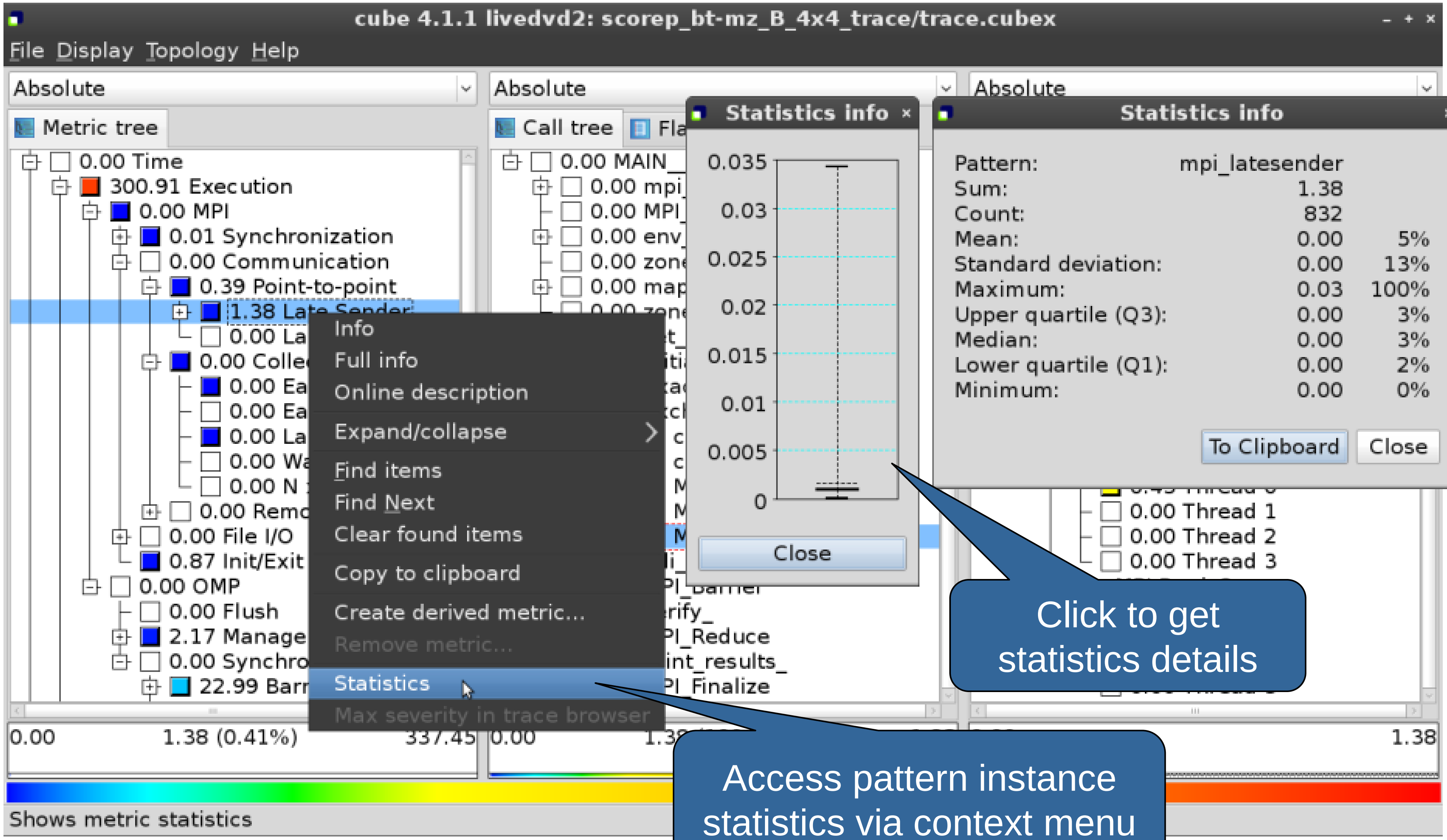
0000 1.2878 (35.9192%) 3.5853

0.0000 1.2878

Ready

Critical-path imbalance highlights inefficient parallelism

Pattern instance statistics



```
0.00 Time
  300.91 Execution
    0.00 MPI
      0.01 Synchronization
      0.00 Communication
        0.39 Point-to-point
          1.38 Late Sender
```

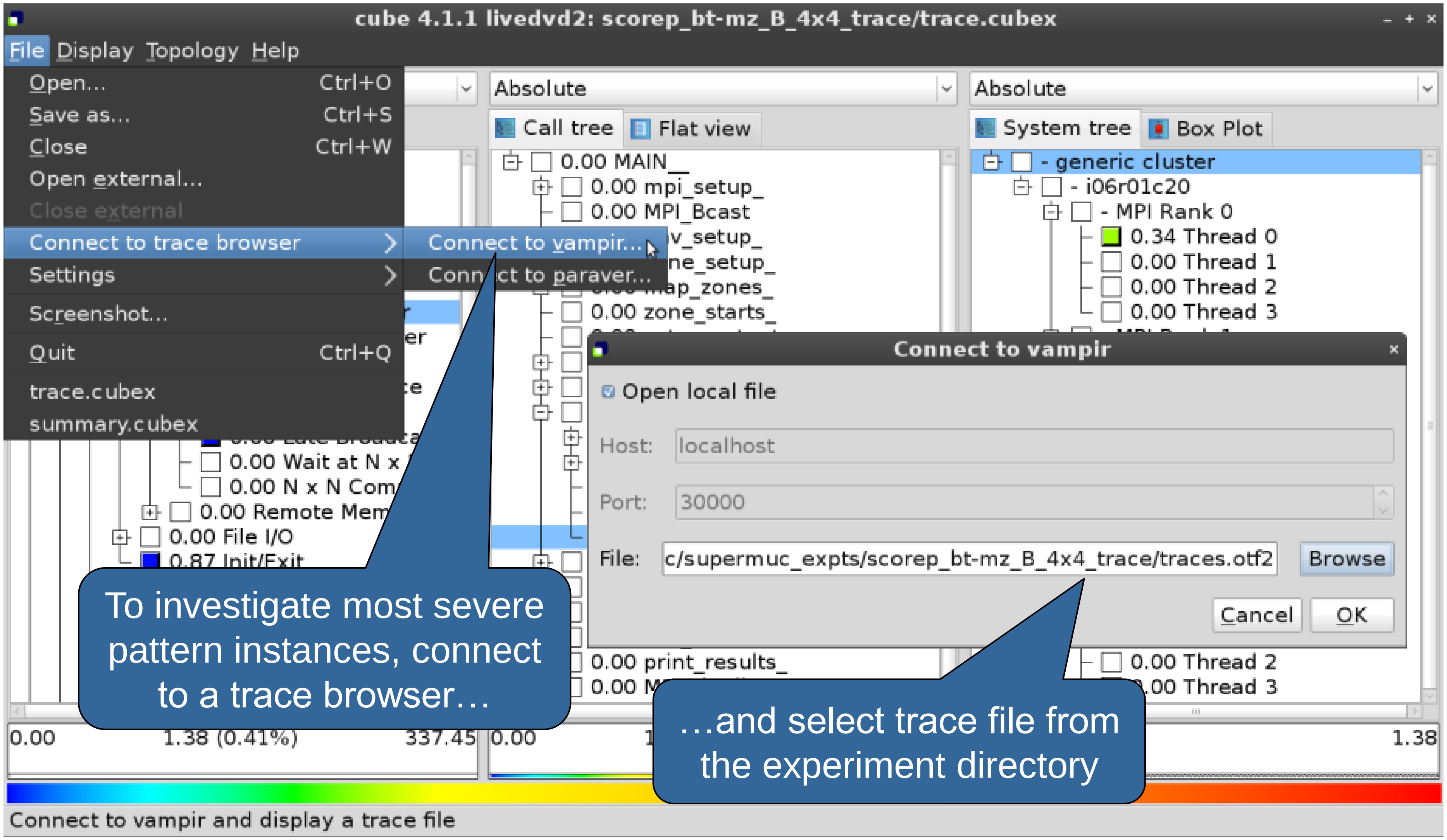
Statistics info

Pattern:	mpi_latesender	
Sum:	1.38	
Count:	832	
Mean:	0.00	5%
Standard deviation:	0.00	13%
Maximum:	0.03	100%
Upper quartile (Q3):	0.00	3%
Median:	0.00	3%
Lower quartile (Q1):	0.00	2%
Minimum:	0.00	0%

Click to get statistics details

Access pattern instance statistics via context menu

Connect to Vampir trace browser



cube 4.1.1 livedvd2: scorep_bt-mz_B_4x4_trace/trace.cubex

Connect to vampir

☑ Open local file

Host: localhost

Port: 30000

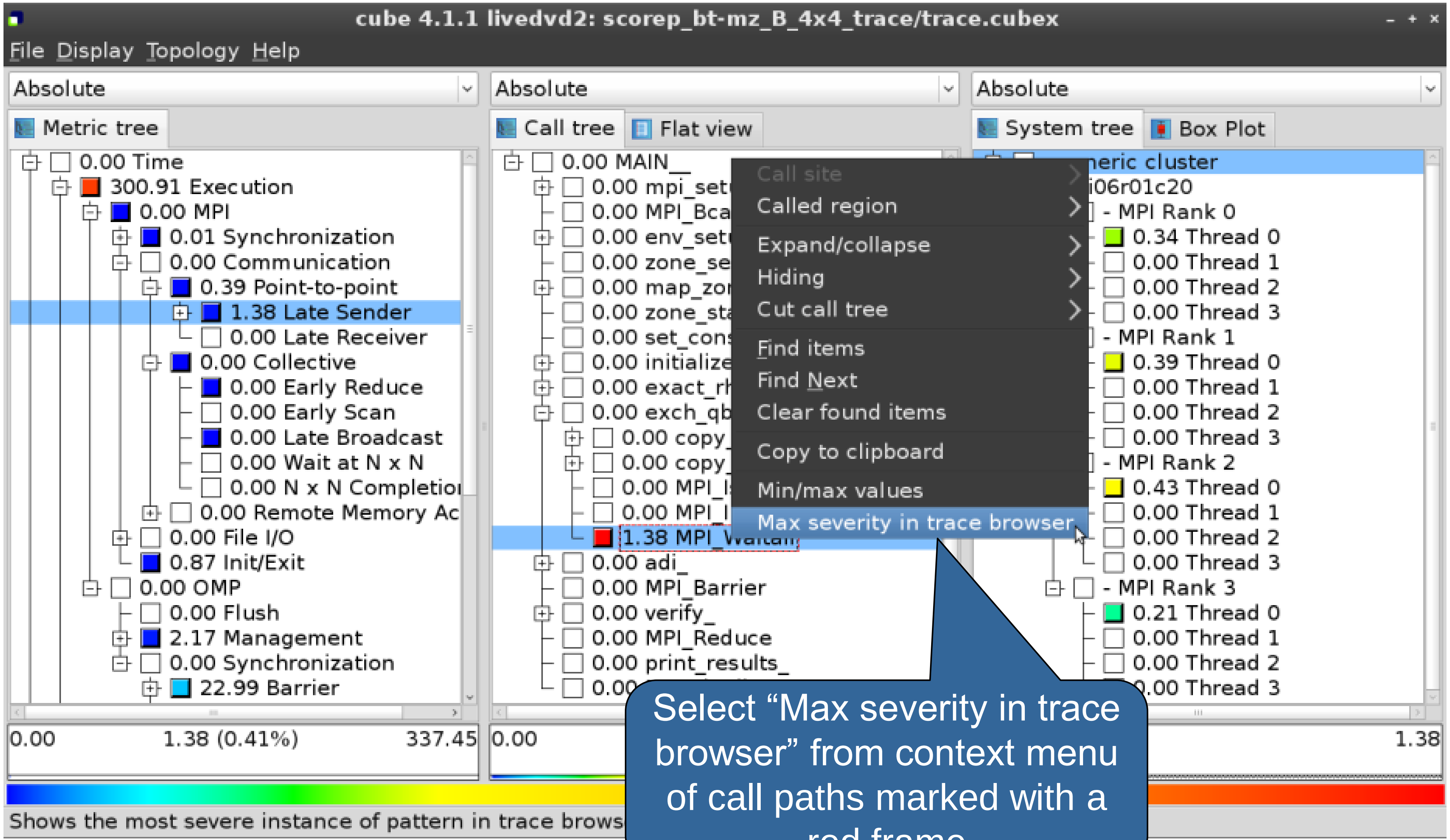
File: c/supermuc_expts/scorep_bt-mz_B_4x4_trace/traces.otf2

Connect to vampir and display a trace file

To investigate most severe pattern instances, connect to a trace browser…

…and select trace file from the experiment directory

Show most severe pattern instances



cube 4.1.1 livedvd2: scorep_bt-mz_B_4x4_trace/trace.cubex

File Display Topology Help

Absolute | Absolute | Absolute

Metric tree

```
0.00 Time
  300.91 Execution
    0.00 MPI
      0.01 Synchronization
      0.00 Communication
        0.39 Point-to-point
          1.38 Late Sender
          0.00 Late Receiver
        0.00 Collective
          0.00 Early Reduce
          0.00 Early Scan
          0.00 Late Broadcast
          0.00 Wait at N x N
          0.00 N x N Completio
        0.00 Remote Memory Ac
      0.00 File I/O
      0.87 Init/Exit
    0.00 OMP
      0.00 Flush
      2.17 Management
      0.00 Synchronization
        22.99 Barrier
```

Call tree | Flat view

```
0.00 MAIN__
  0.00 mpi_set
  0.00 MPI_Bca
  0.00 env_set
  0.00 zone_se
  0.00 map_zo
  0.00 zone_st
  0.00 set_con
  0.00 initialize
  0.00 exact_r
  0.00 exch_qb
    0.00 copy
    0.00 copy
    0.00 MPI_I
    0.00 MPI_I
    1.38 MPI_Waitall
  0.00 adi_
  0.00 MPI_Barrier
  0.00 verify_
  0.00 MPI_Reduce
  0.00 print_results_
  0.00
```

System tree | Box Plot

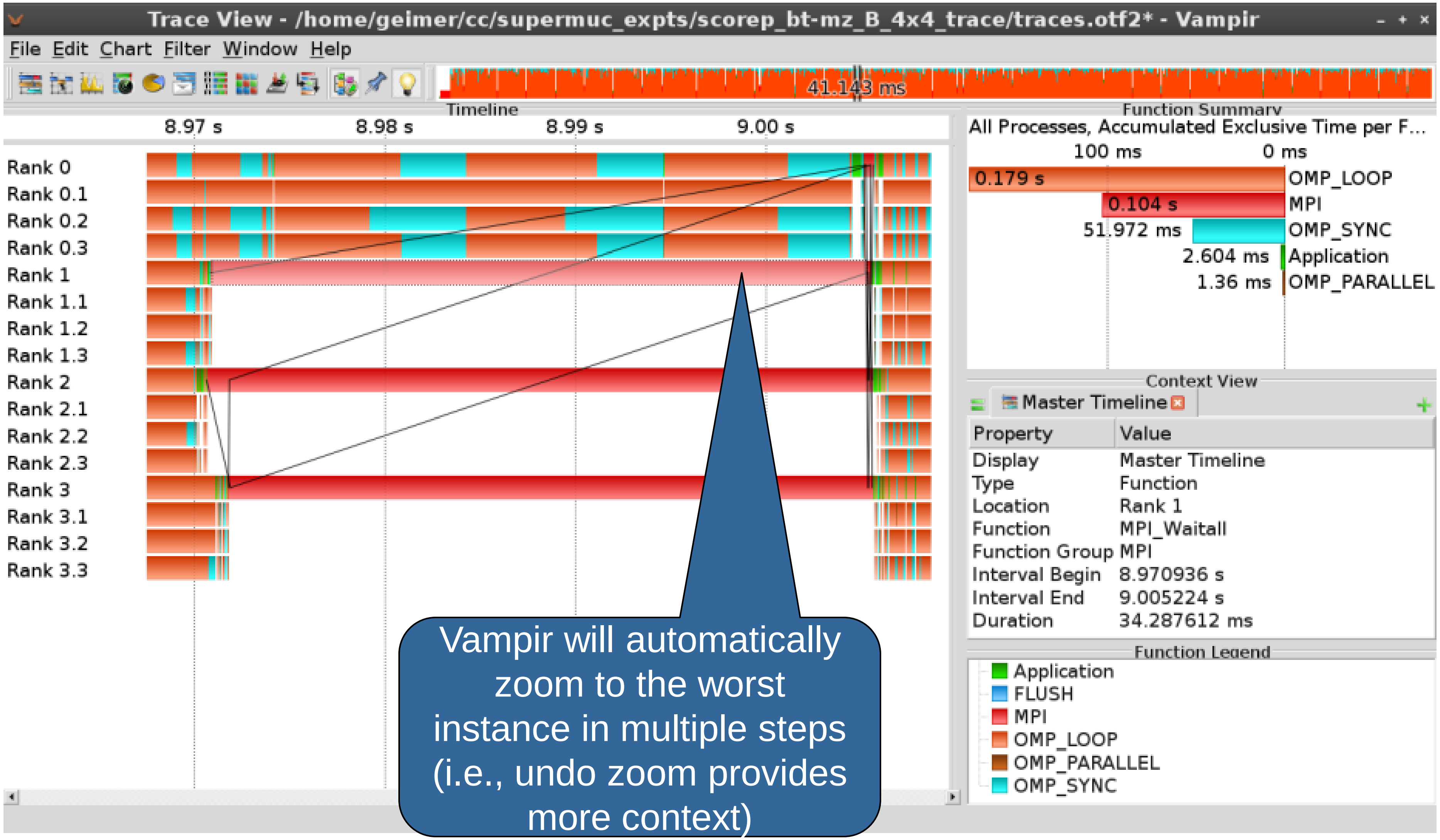
```
eric cluster
i06r01c20
  - MPI Rank 0
    0.34 Thread 0
    0.00 Thread 1
    0.00 Thread 2
    0.00 Thread 3
  - MPI Rank 1
    0.39 Thread 0
    0.00 Thread 1
    0.00 Thread 2
    0.00 Thread 3
  - MPI Rank 2
    0.43 Thread 0
    0.00 Thread 1
    0.00 Thread 2
    0.00 Thread 3
  - MPI Rank 3
    0.21 Thread 0
    0.00 Thread 1
    0.00 Thread 2
    0.00 Thread 3
```

0.00 1.38 (0.41%) 337.45 | 0.00 | 1.38

Shows the most severe instance of pattern in trace brows

Select "Max severity in trace browser" from context menu of call paths marked with a red frame

Investigate most severe instance in Vampir



Property	Value
Display	Master Timeline
Type	Function
Location	Rank 1
Function	MPI_Waitall
Function Group	MPI
Interval Begin	8.970936 s
Interval End	9.005224 s
Duration	34.287612 ms

Function Legend
- 🟩 Application
- 🟦 FLUSH
- 🟥 MPI
- 🟧 OMP_LOOP
- 🟫 OMP_PARALLEL
- 🟦 OMP_SYNC

Vampir will automatically zoom to the worst instance in multiple steps (i.e., undo zoom provides more context)

Further information

Scalable performance **a**nalysis of **la**rge-**sca**le parallel **a**pplications

- toolset for scalable performance measurement & analysis of MPI, OpenMP & hybrid parallel applications
- supporting most popular HPC computer systems
- available under New BSD open-source license
- sources, documentation & publications:
  - http://www.scalasca.org
  - mailto: scalasca@fz-juelich.de