Performance Analysis with Periscope

M. Gerndt, V. Petkov,
Y. Oleynik
Technische Universität München

periscope@lrr.in.tum.de

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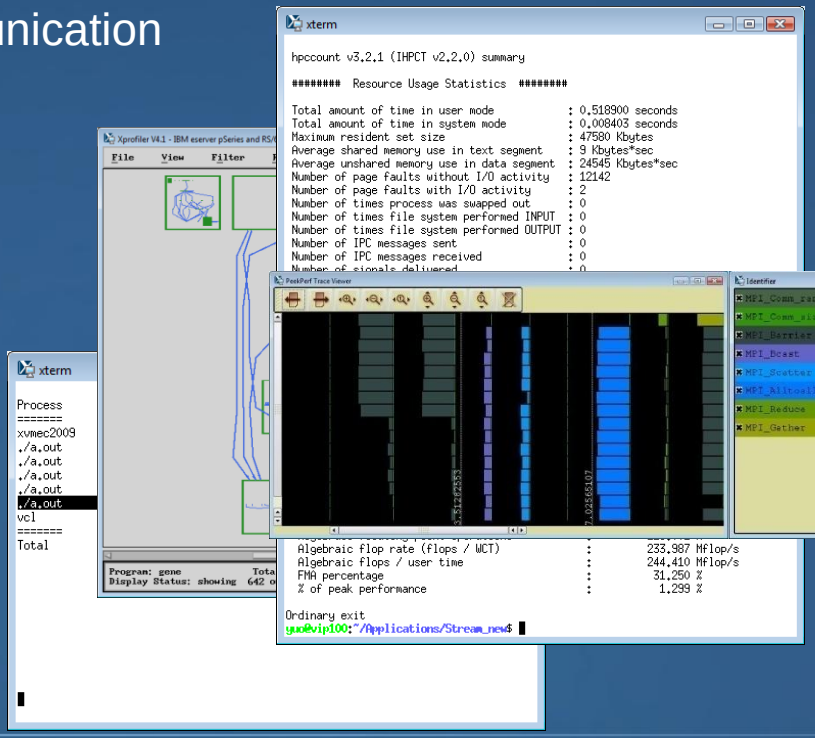
Outline

- Motivation
- Periscope overview
- Periscope performance analysis model
- Performance analysis automation
- Periscope GUI

Motivation

- Performance analysis procedure on POWER6 as an example:
  - Use Tprof to pinpoint time consuming subroutines
  - Use Xprofiler (GUI for gprof) to understand call graph
  - Use hpmcount (libhpm) to measure Hardware Counters
  - Use mpitrace to investigate mpi communication



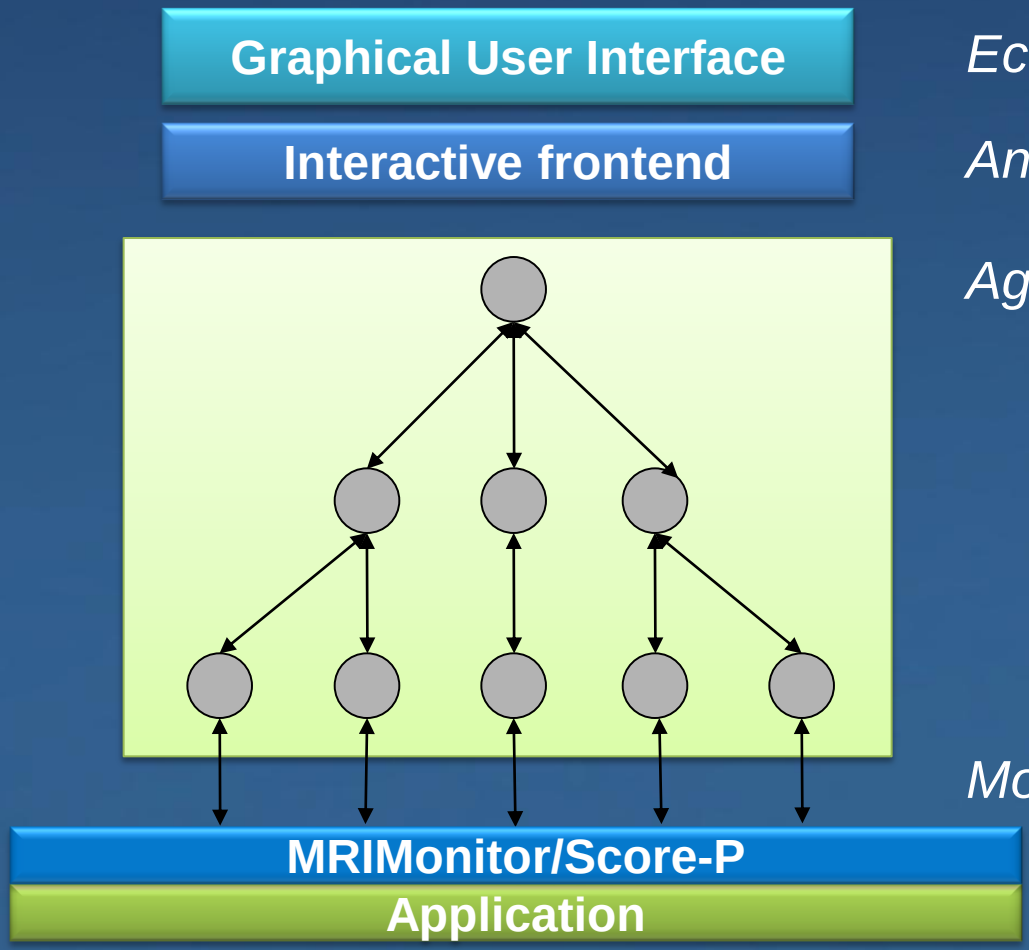
- Problems:
  - Time consuming
  - Error prone
  - Not scalable
  - Requires deep hardware knowledge

- Solution:
  - Performance analysis automation

Periscope

- Distributed architecture
  - Analysis performed by multiple distributed hierarchical agents
- Iterative online analysis
  - Measurements are configured, obtained and evaluated on the fly
  - no tracing!
- Automatic bottlenecks search
  - Based on performance optimization experts' knowledge
- Enhanced GUI
  - Eclipse based integrated development and performance analysis environment
- Instrumentation
  - Fortran, C/C++
  - Automatic overhead control

Distributed Architecture



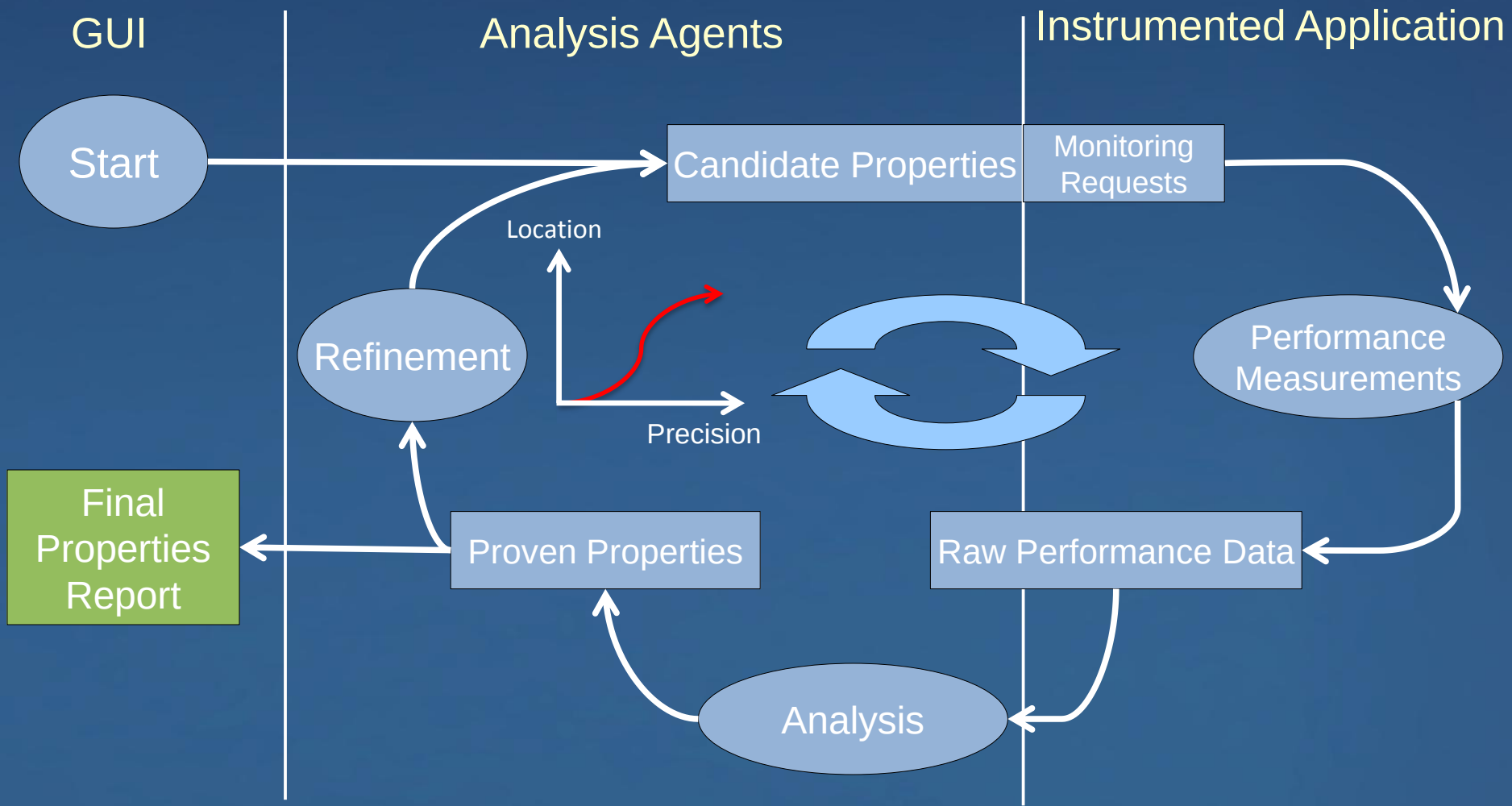
Eclipse-based GUI

Analysis control

Agents network

Monitoring Request Interface

Iterative Online Analysis

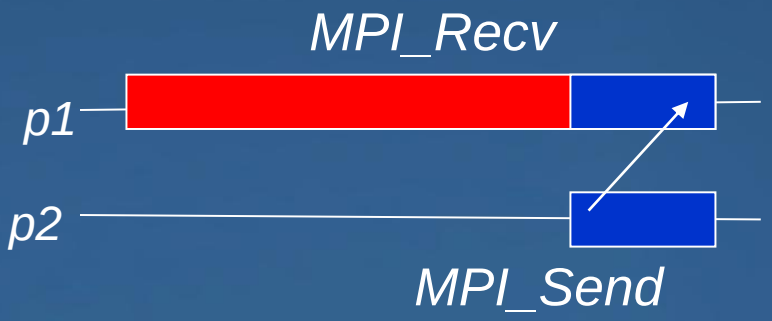


Automatic search for bottlenecks

- Automation based on formalized expert knowledge
  - Potential performance problems → properties
  - Efficient search algorithm → search strategies
- Performance property
  - Condition
  - Confidence
  - Severity
- Performance analysis strategies
  - Westmere Single-node Analysis
  - Itanium2 Stall Cycle Analysis
  - IBM POWER6 Single Core Performance Analysis
  - MPI Communication Pattern Analysis
  - Generic Memory Analysis
  - OpenMP-based Performance Analysis
  - Scalability Analysis – OpenMP codes

Example Properties

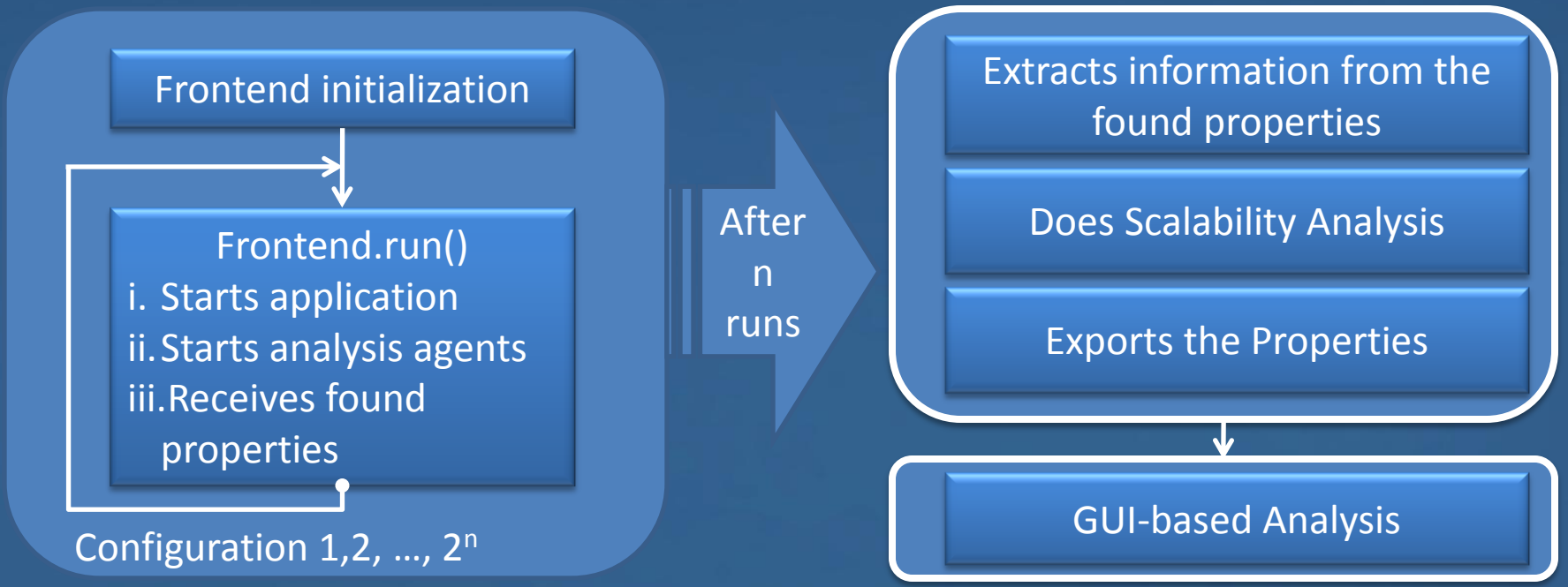
- StallCycles (Region, Rank, Thread, Metric, Phase)
  - Condition
    - Percentage of lost cycles >30%
  - Severity
    - Percentage of lost cycles
- MPI Late Sender
  - Automatic detection of wait patterns
  - Measurement on the fly
  - No tracing required!

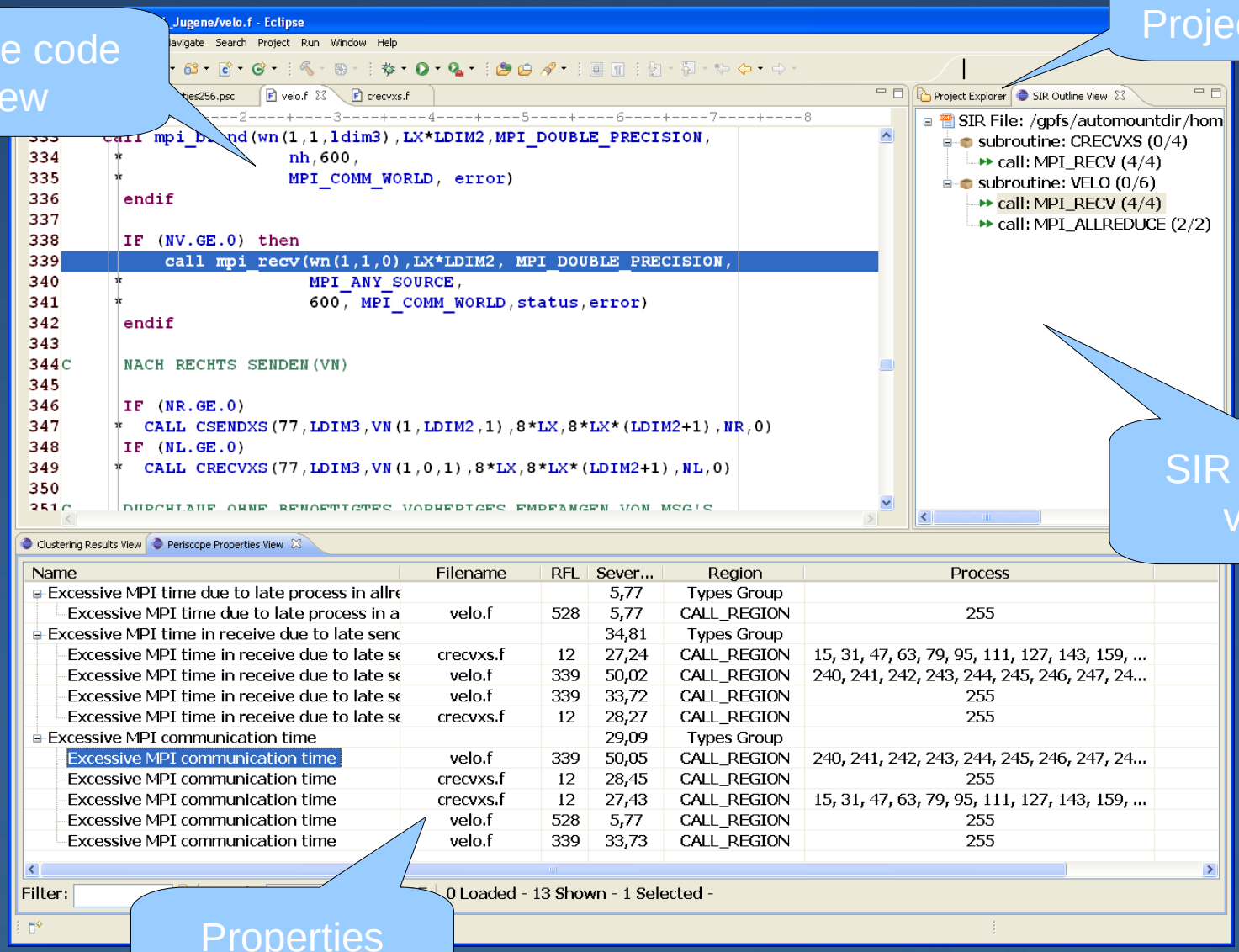


- OpenMP Synchronization properties
  - Critical section overhead property
  - Frequent atomic property

Scalability Analysis – OpenMP codes

- Identifies the OpenMP code regions that do not scale well
- Scalability Analysis is done by the frontend / restarts the application /
- **No need to manually configure the runs and find the speedup!**




Source code view
Project view
SIR outline view
Properties view
Jugene/velo.f - Eclipse
Navigate Search Project Run Window Help
velo.f
crecvxs.f
Project Explorer
SIR Outline View
SIR File: /gpfs/automountdir/hom
subroutine: CRECVXS (0/4)
call: MPI_RECV (4/4)
subroutine: VELO (0/6)
call: MPI_RECV (4/4)
call: MPI_ALLREDUCE (2/2)
call mpi_b nd(wn(1,1,ldim3),LX*LDIM2,MPI_DOUBLE_PRECISION,
* nh,600,
* MPI_COMM_WORLD, error)
endif
IF (NV.GE.0) then
call mpi_recv(wn(1,1,0),LX*LDIM2, MPI_DOUBLE_PRECISION,
* MPI_ANY_SOURCE,
* 600, MPI_COMM_WORLD,status,error)
endif
NACH RECHTS SENDEN(VN)
IF (NR.GE.0)
* CALL CSENDXS(77,LDIM3,VN(1,LDIM2,1),8*LX,8*LX*(LDIM2+1),NR,0)
IF (NL.GE.0)
* CALL CRECVXS(77,LDIM3,VN(1,0,1),8*LX,8*LX*(LDIM2+1),NL,0)
Clustering Results View
Periscope Properties View
Name | Filename | RFL | Sever... | Region | Process
Excessive MPI time due to late process in allre | | | 5,77 | Types Group |
Excessive MPI time due to late process in a | velo.f | 528 | 5,77 | CALL_REGION | 255
Excessive MPI time in receive due to late send | | | 34,81 | Types Group |
Excessive MPI time in receive due to late se | crecvxs.f | 12 | 27,24 | CALL_REGION | 15, 31, 47, 63, 79, 95, 111, 127, 143, 159, ...
Excessive MPI time in receive due to late se | velo.f | 339 | 50,02 | CALL_REGION | 240, 241, 242, 243, 244, 245, 246, 247, 24...
Excessive MPI time in receive due to late se | velo.f | 339 | 33,72 | CALL_REGION | 255
Excessive MPI time in receive due to late se | crecvxs.f | 12 | 28,27 | CALL_REGION | 255
Excessive MPI communication time | | | 29,09 | Types Group |
Excessive MPI communication time | velo.f | 339 | 50,05 | CALL_REGION | 240, 241, 242, 243, 244, 245, 246, 247, 24...
Excessive MPI communication time | crecvxs.f | 12 | 28,45 | CALL_REGION | 255
Excessive MPI communication time | crecvxs.f | 12 | 27,43 | CALL_REGION | 15, 31, 47, 63, 79, 95, 111, 127, 143, 159, ...
Excessive MPI communication time | velo.f | 528 | 5,77 | CALL_REGION | 255
Excessive MPI communication time | velo.f | 339 | 33,73 | CALL_REGION | 255
Filter:
0 Loaded - 13 Shown - 1 Selected -

Thank you for your attention!

- Current version 1.4
  - Available under: http://www.lrr.in.tum.de/periscope/Download
- Supported architectures
  - SGI Altix 4700 Itanium2
  - IBM Power575 POWER6
  - IBM BlueGene/P
  - x86/x64-based architectures
- Further information:
  - Periscope web page: http://www.lrr.in.tum.de/periscope
  - Contact us directly at: periscope@lrr.in.tum.de