# Performance Analysis with Vampir

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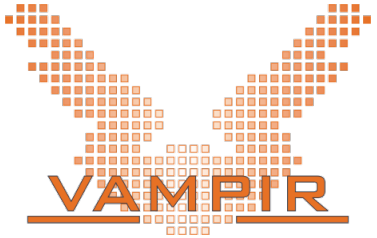
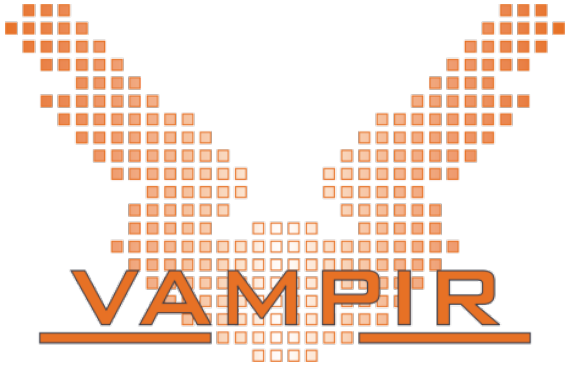



Content derived from slides by Ronny Tschüter, Bert Wesarg and Matthias Weber
(Technische Universität Dresden)

# Outline

- **Part I: Vampir Tool Suite**
  - Event trace visualization
  - The Vampir displays
  - Visualization modes




- **Part II: Vampir Hands-On**
  - Visualizing and analyzing NPB-MZ-MPI / BT

# Event Trace Visualization with Vampir

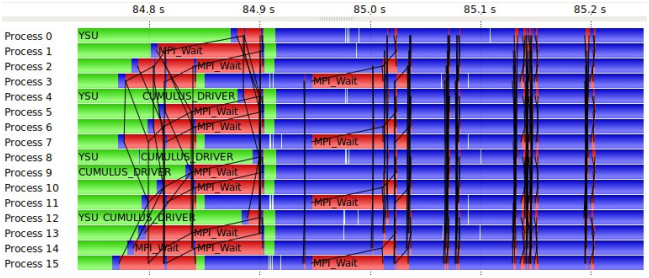
- Display and analyze performance data
- Show dynamic run-time behavior graphically
- Provide statistics and performance metrics
- Optimized displays to quickly identify problem areas/faulty parts of program code

**Use Vampir to visualize:**

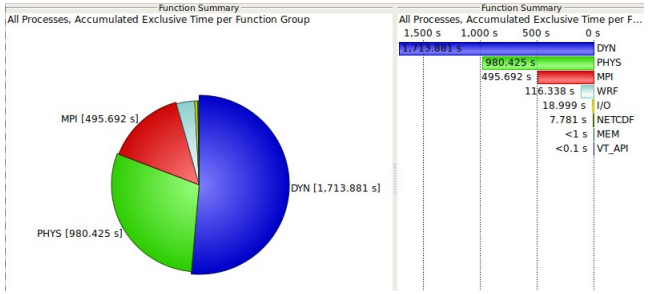
– application execution during a given time in a given process/thread
– communication patterns during application execution
– imbalances in computation, I/O or memory usage
- effect of imbalances on the parallel execution of application

# The main displays of Vampir

- Timeline Charts: Show application activities and communication along a time axis
  -  Master Timeline
  -  Process Timeline
  -  Counter Data Timeline
  -  Performance Radar




- Summary Charts: Provide quantitative results for the currently selected time interval
  -  Function Summary
  -  Message Summary
  -  Process Summary
  -  Communication Matrix View

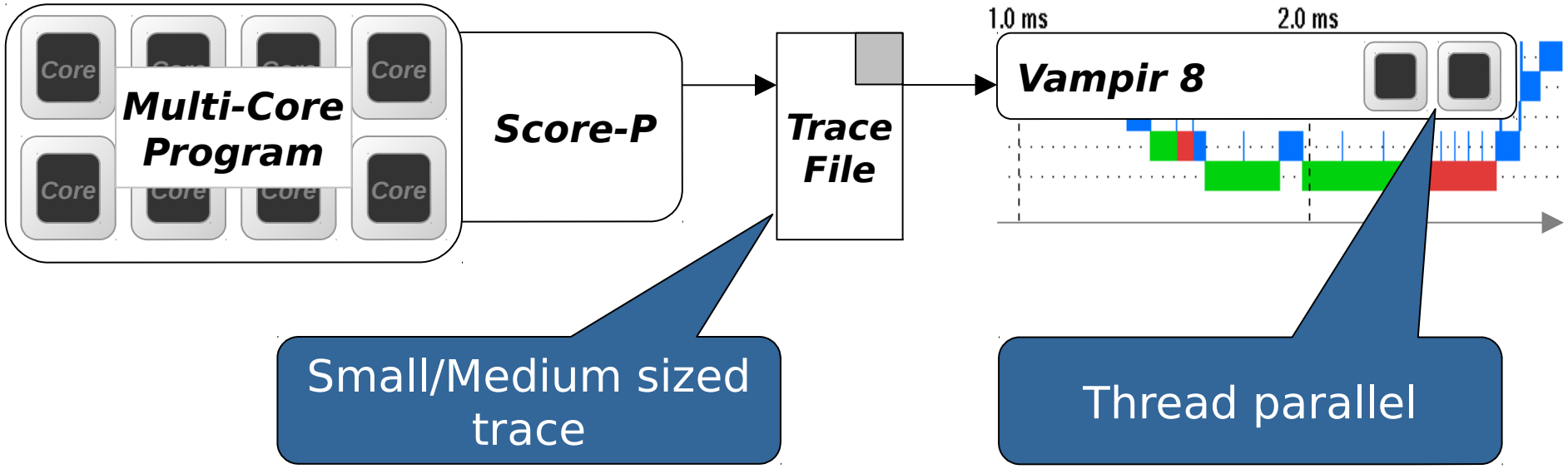


# Additional displays of Vampir

- I/O Summary – summary of input/output operations
- Call Tree Summary – invocation hierarchy of all monitored functions in a tree representation. Shows callers and callees

# Visualization Modes (1)
## Directly on front end or local machine

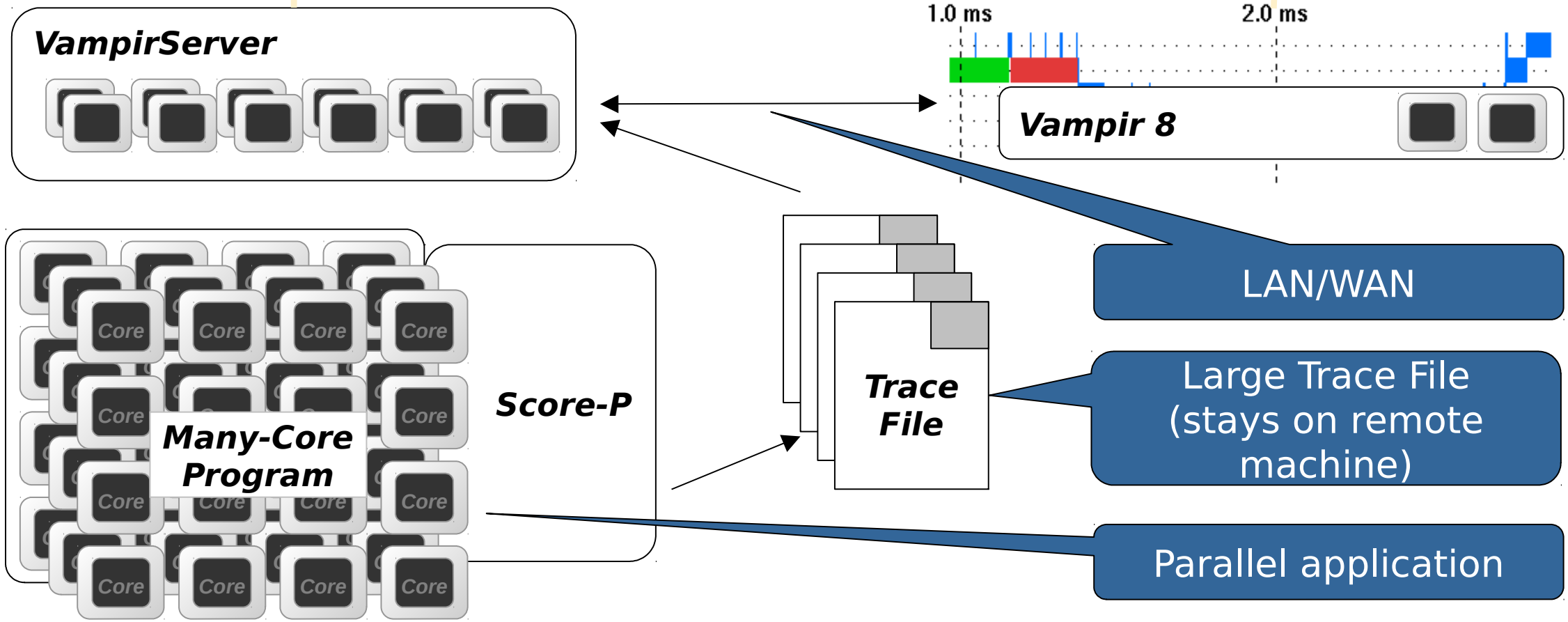
```
% vampir
```



# Visualization Modes (2)
## On local machine with remote VampirServer

```
% vampirserver start
```

```
% vampir
```



# Hands-on:
# Visualizing and analyzing NPB-MZ-MPI / BT

# Help! Where is my trace file?

```
% ls tutorial/NPB3.3-MZ-MPI/bin.scorep/scorep_bt-mz_B_4x4_trace/
scorep.cfg  scorep.filt  scorep.log  scorep.score
scout.cubex scout.log  trace.cubex  traces  traces.def
traces.otf2  trace.stat
```

- If you followed the Score-P hands-on up to the trace experiment

# Starting Vampir on SuperMUC

```
% module load vampir
% vampir traces.otf2
```

Enable X server forwarding while logging in on the SuperMUC

ssh -X user@supermuc.lrz.de

# Starting VampirServer

```
% vampirserver start -t 30
```

Start VampirServer on SuperMUC

# Starting VampirServer

```
% vampirserver start -t 30
Launching VampirServer...
--------LRZ system integration (start message)------------
SuperMUC LoadLeveler job has the ID: srv04-ib.1055953.0
Please abort with the llcancel command once done,
and ignore the following "abort with" message.
--------LRZ system integration (end message)-------------
INFO: Notification set to NEVER!
VampirServer 7.5.0
Licensed to LRZ
Running 16 analysis processes... (abort with vampirserver stop 4025)
VampirServer [redacted] listens on: [redacted]
```

Server ID

Copy host:port

# Enable Port Forwarding

```
% ssh -L 30080:localhost:30090 <username>@lxhalle.in.tum.de
```

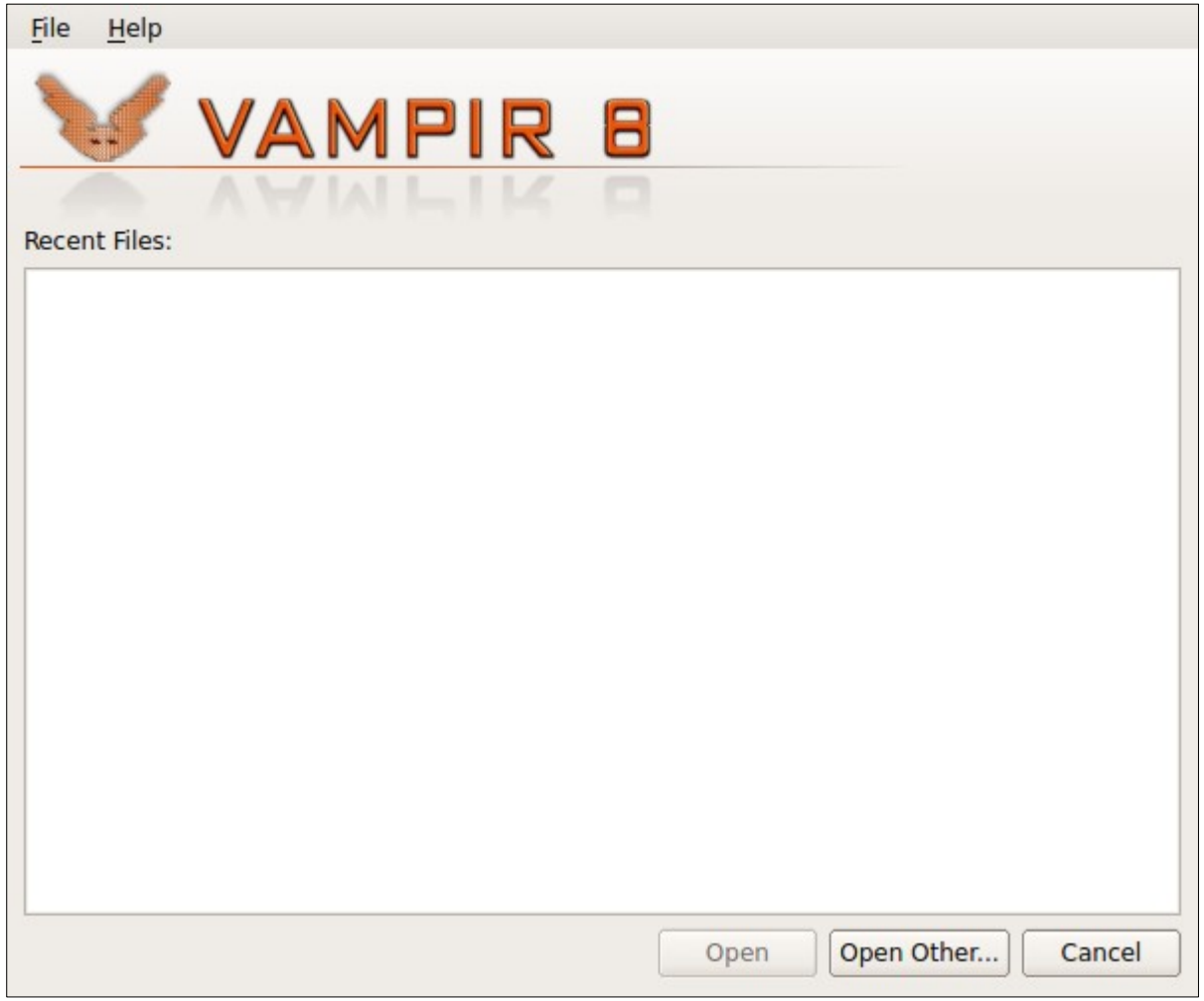
- Open a port forwarding to lxhalle from your local machine

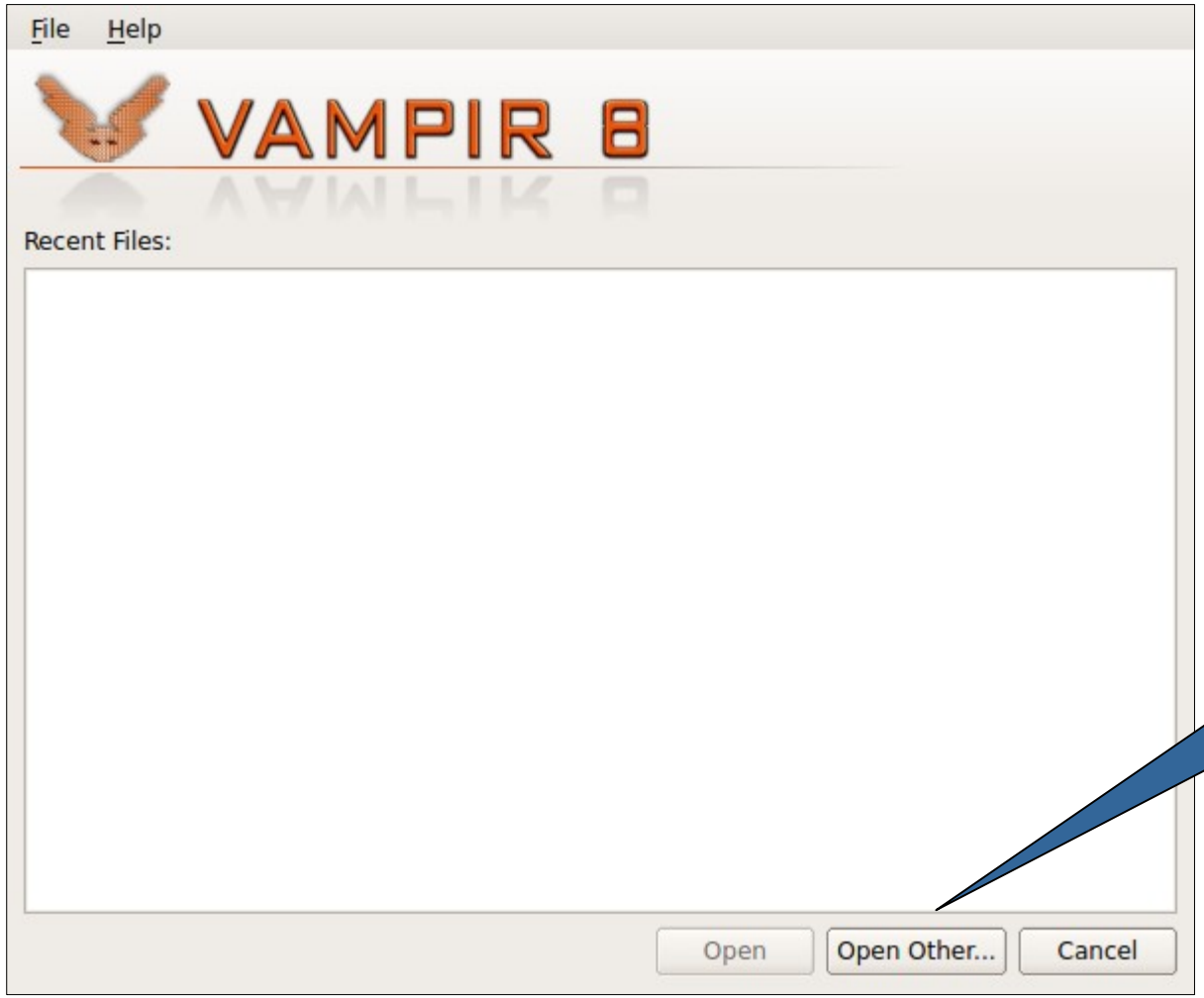
```
% ssh -L 30090:[redacted]<username>@supermuc.lrz.de
```

- Open a port forwarding to SuperMUC to be able to access the VampirServer

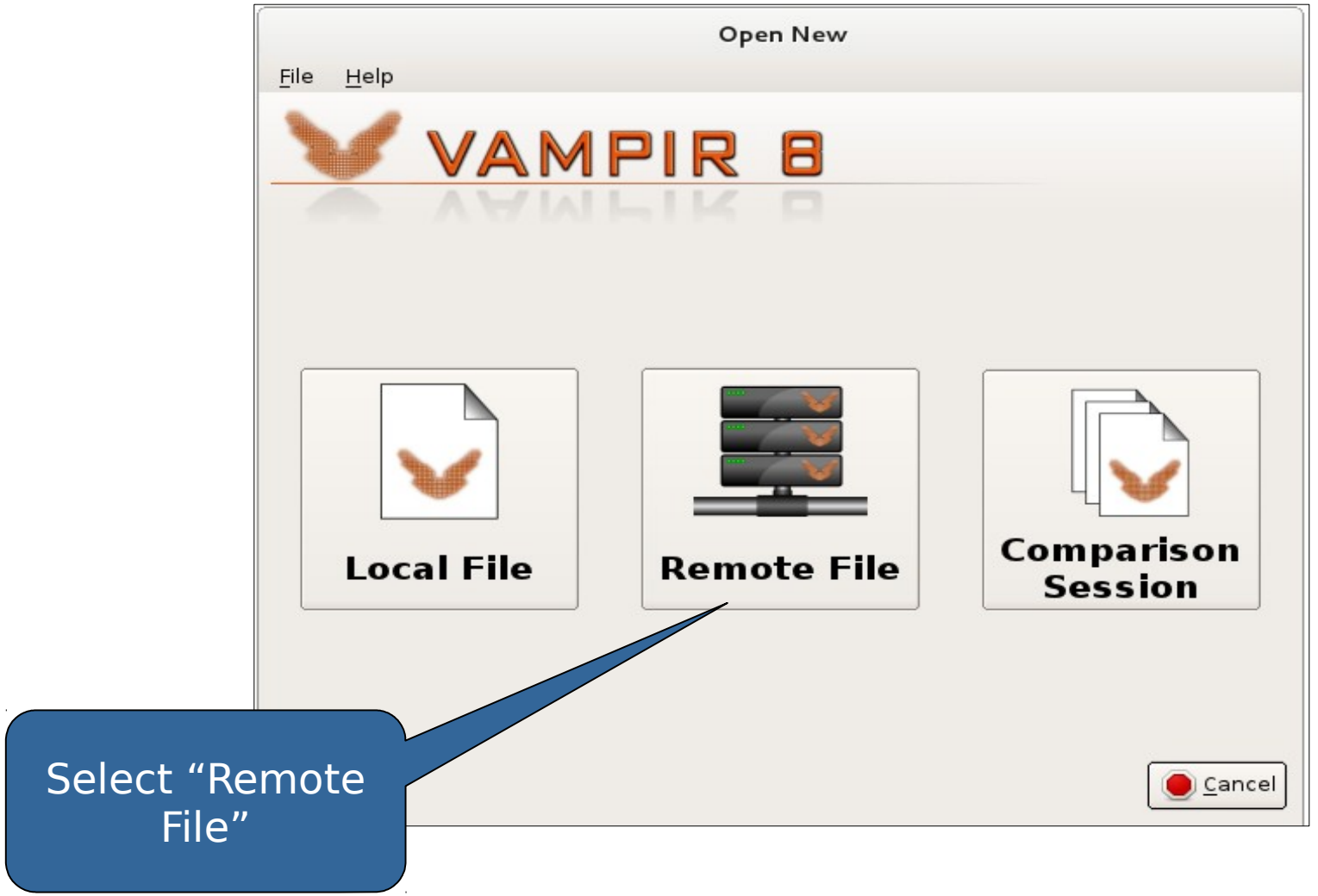
host:port from VampirServer output

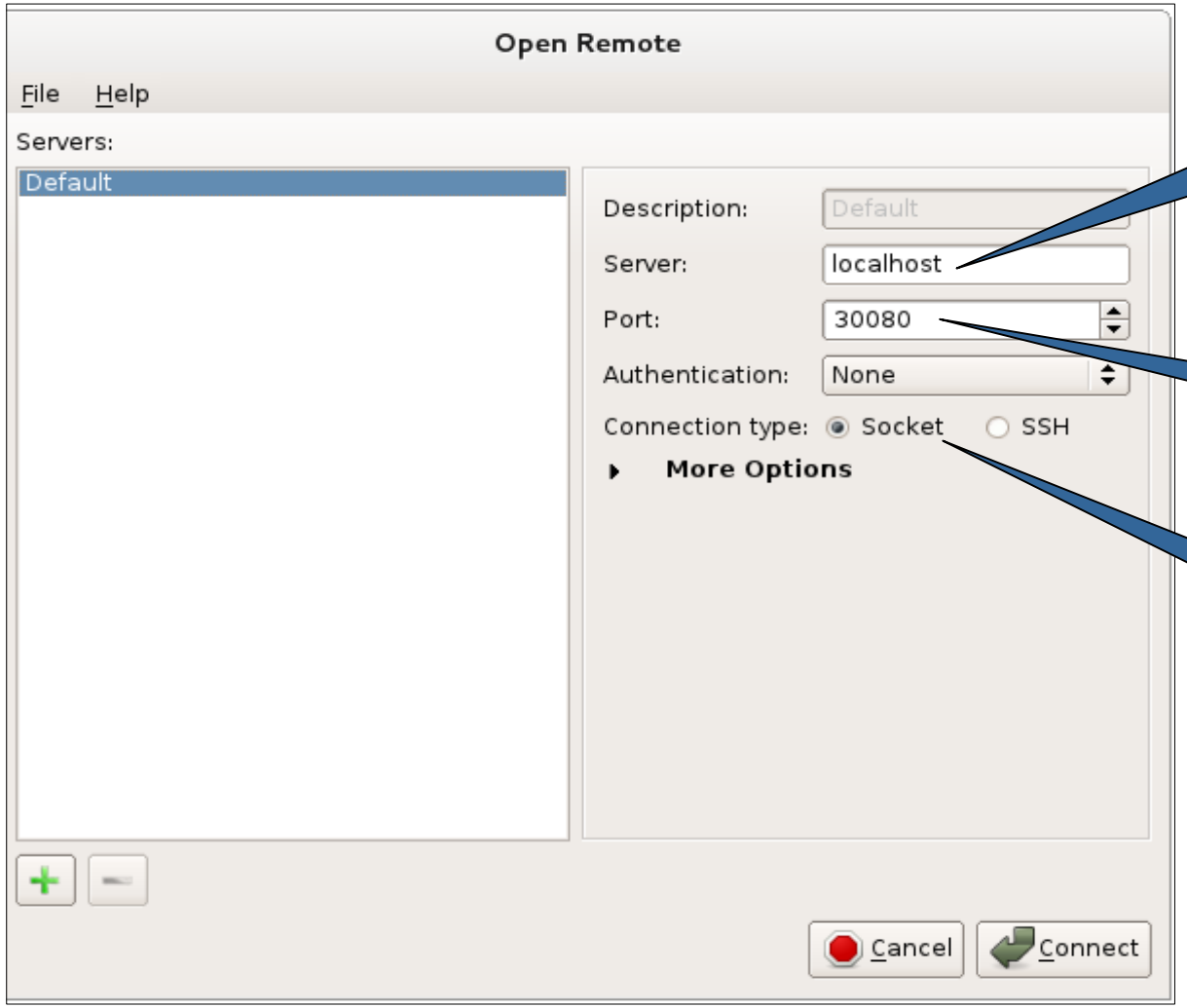
# Start Vampir on local computer

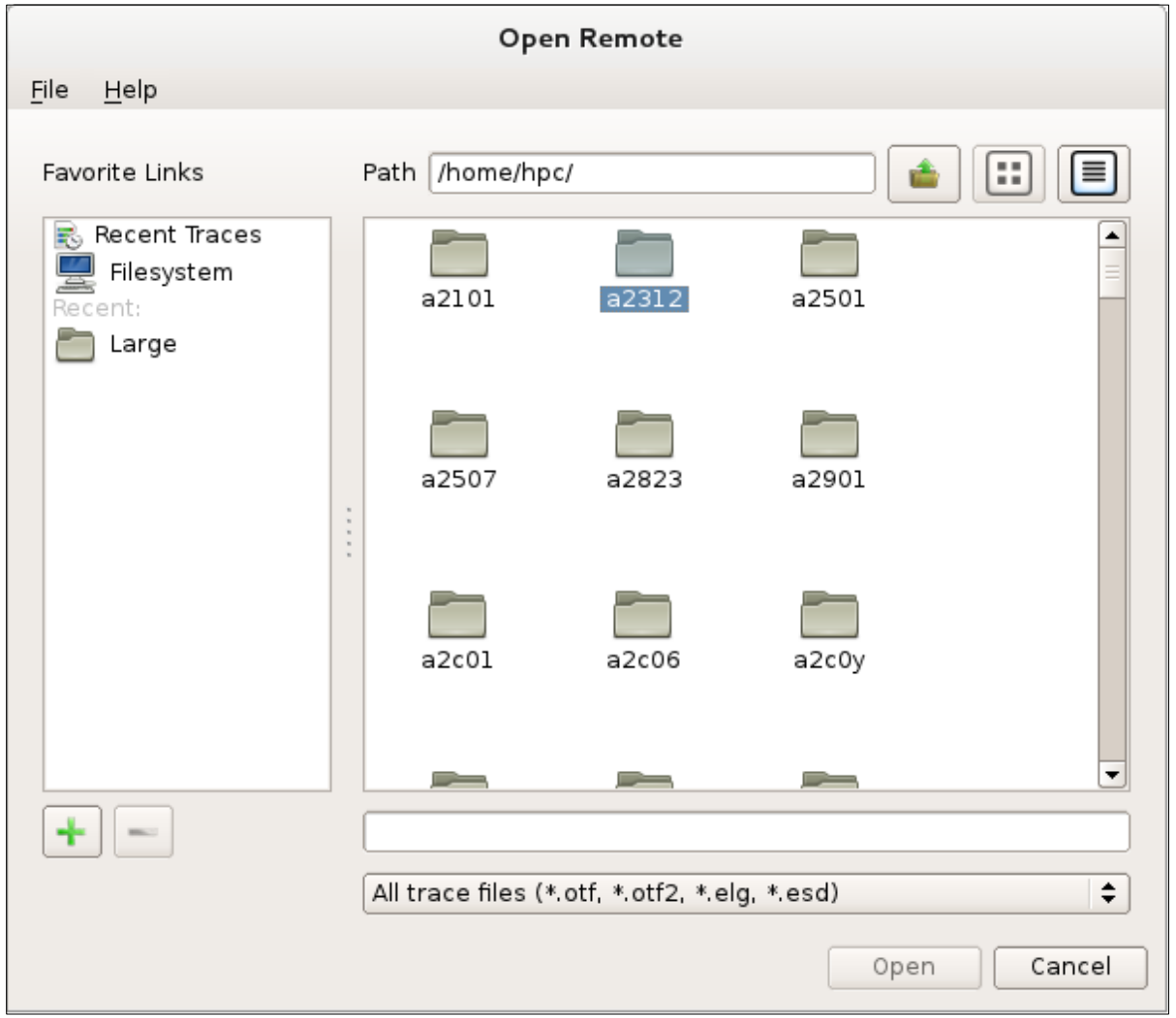





Use the “Open Other” option


Open New
File
Help
VAMPIR 8
Local File
Remote File
Comparison Session
Cancel
Select “Remote File”

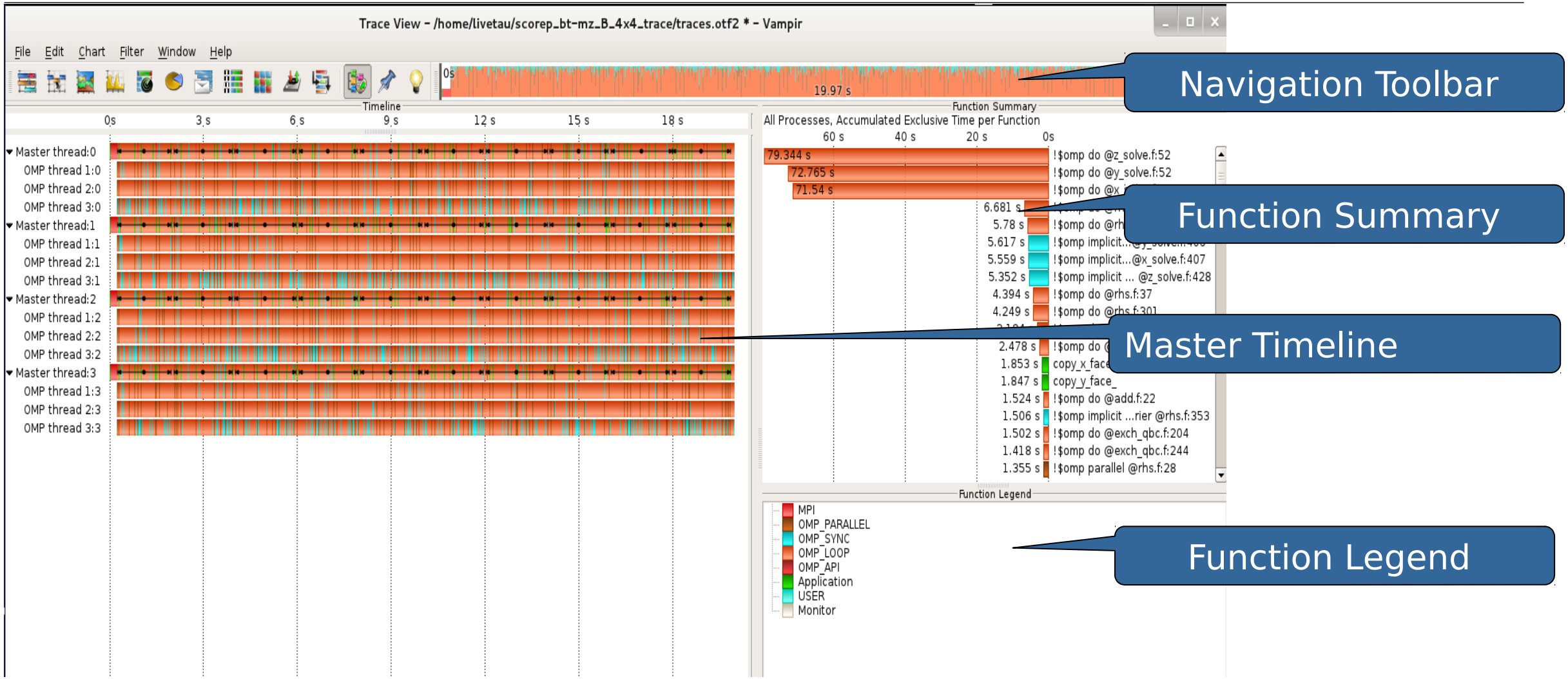

Open Remote
File
Help
Servers:
Default
Description:
Default
Server:
localhost
Port:
30080
Authentication:
None
Connection type:
Socket
SSH
More Options
Cancel
Connect
Server is “localhost”
Port is “30080”
Connection type “Socket”


Open Remote
File
Help
Favorite Links
Path
/home/hpc/
Recent Traces
Filesystem
Recent:
Large
a2101
a2312
a2501
a2507
a2823
a2901
a2c01
a2c06
a2c0y
All trace files (*.otf, *.otf2, *.elg, *.esd)
Open
Cancel

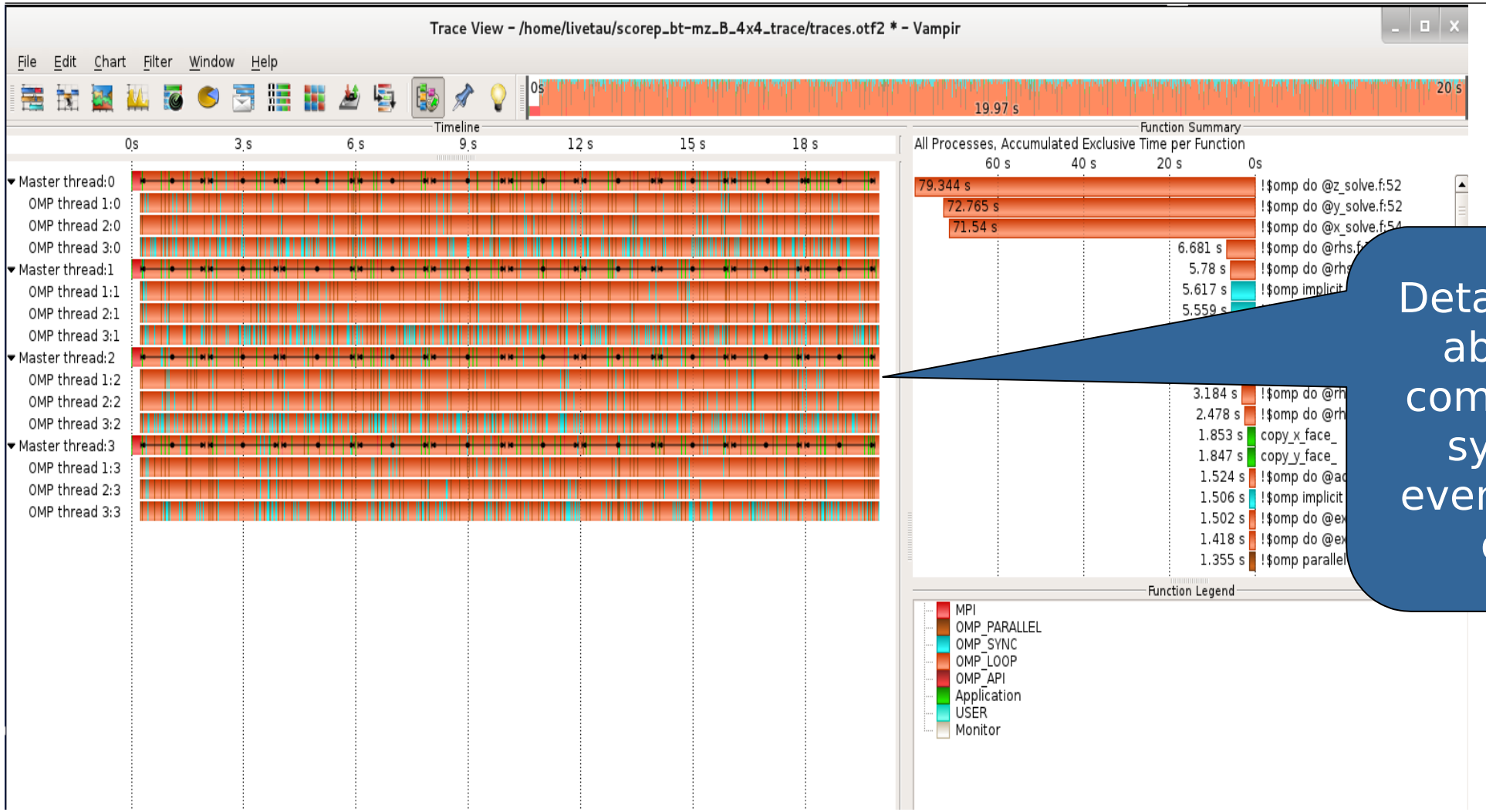
# NOTE:

- Use Vampir on your local system to increase responsiveness
- Copy your trace directory to your local machine and open the trace (otf2) from the GUI

# Visualization of the NPB-MZ-MPI / BT trace

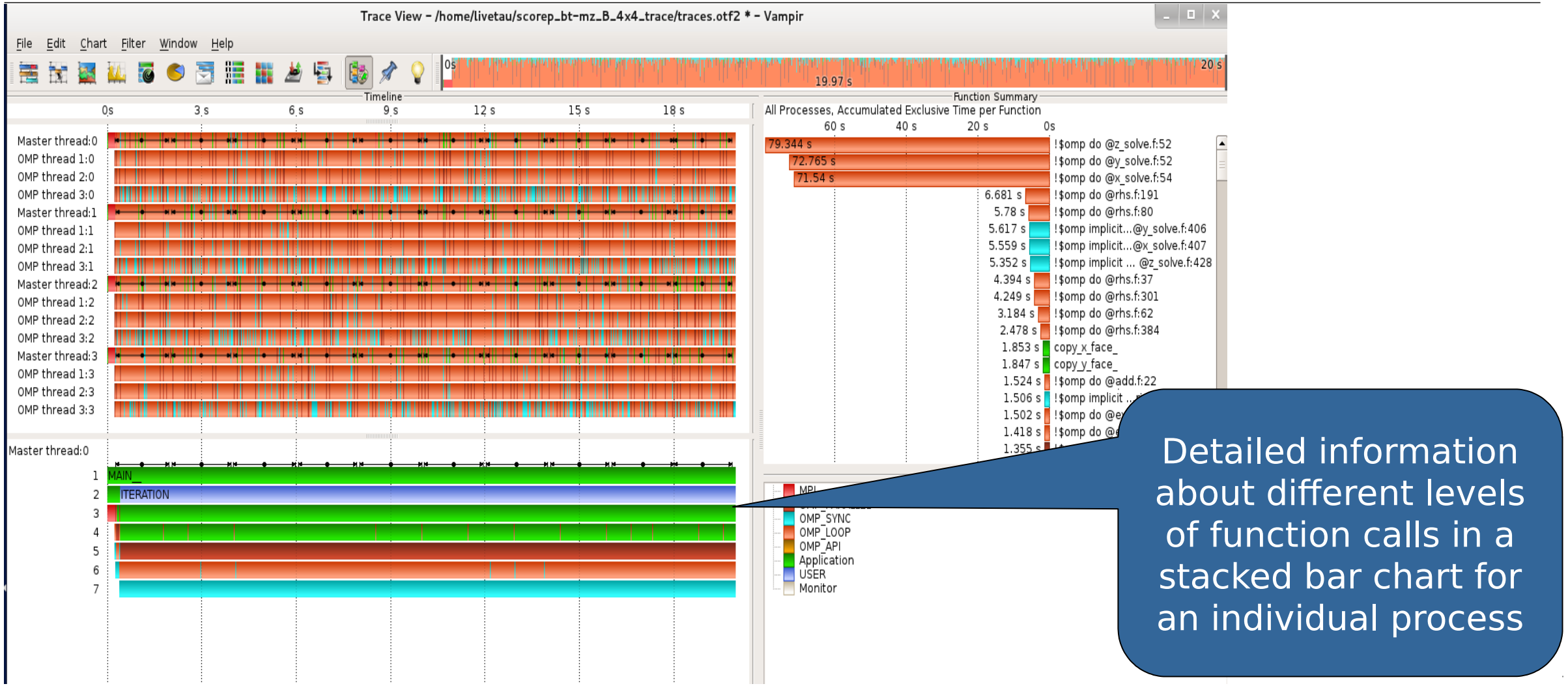


# Visualization of the NPB-MZ-MPI / BT trace
## Master Timeline



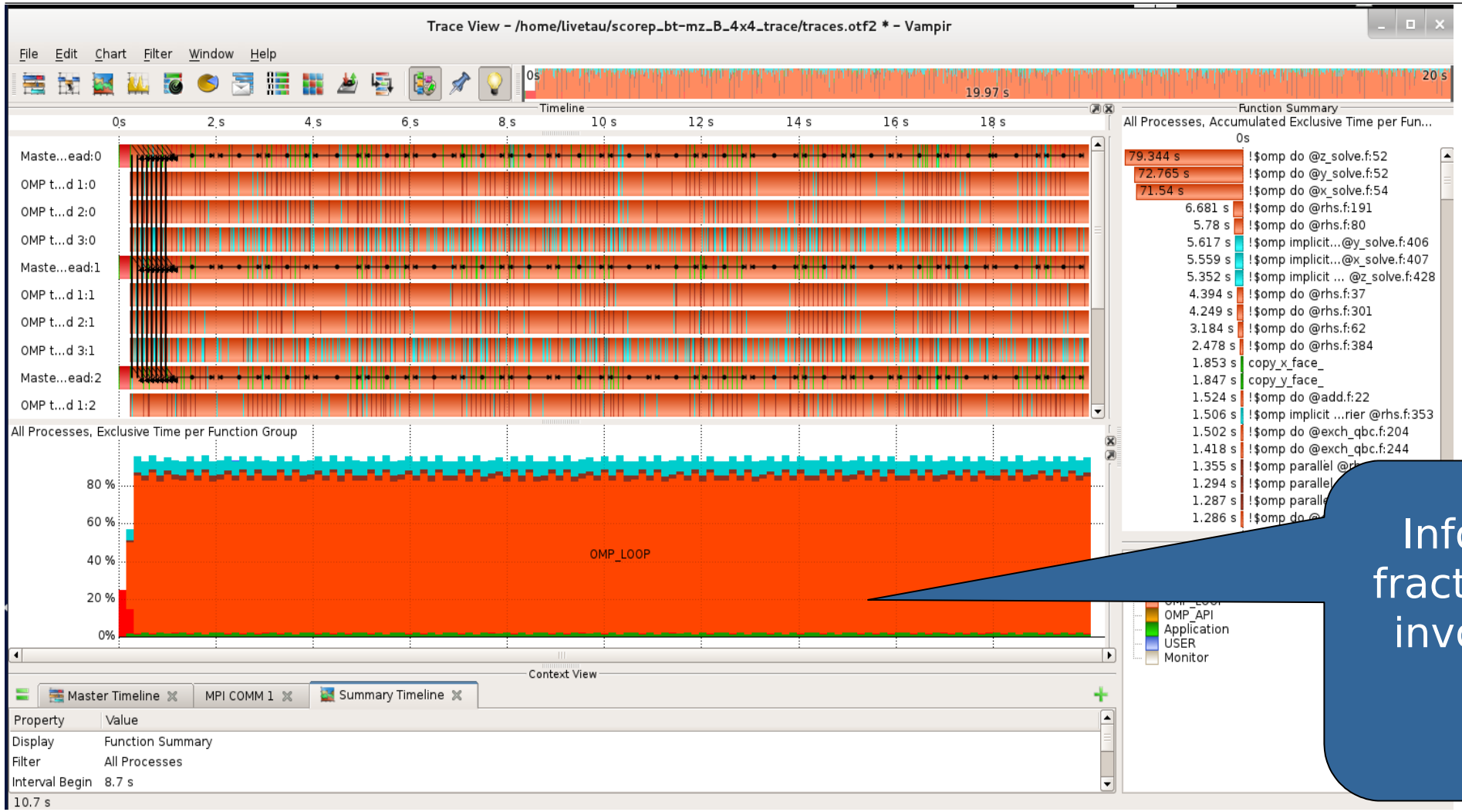

Detailed information about functions, communication and synchronization events for collection of processes

# Visualization of the NPB-MZ-MPI / BT trace
## Process Timeline



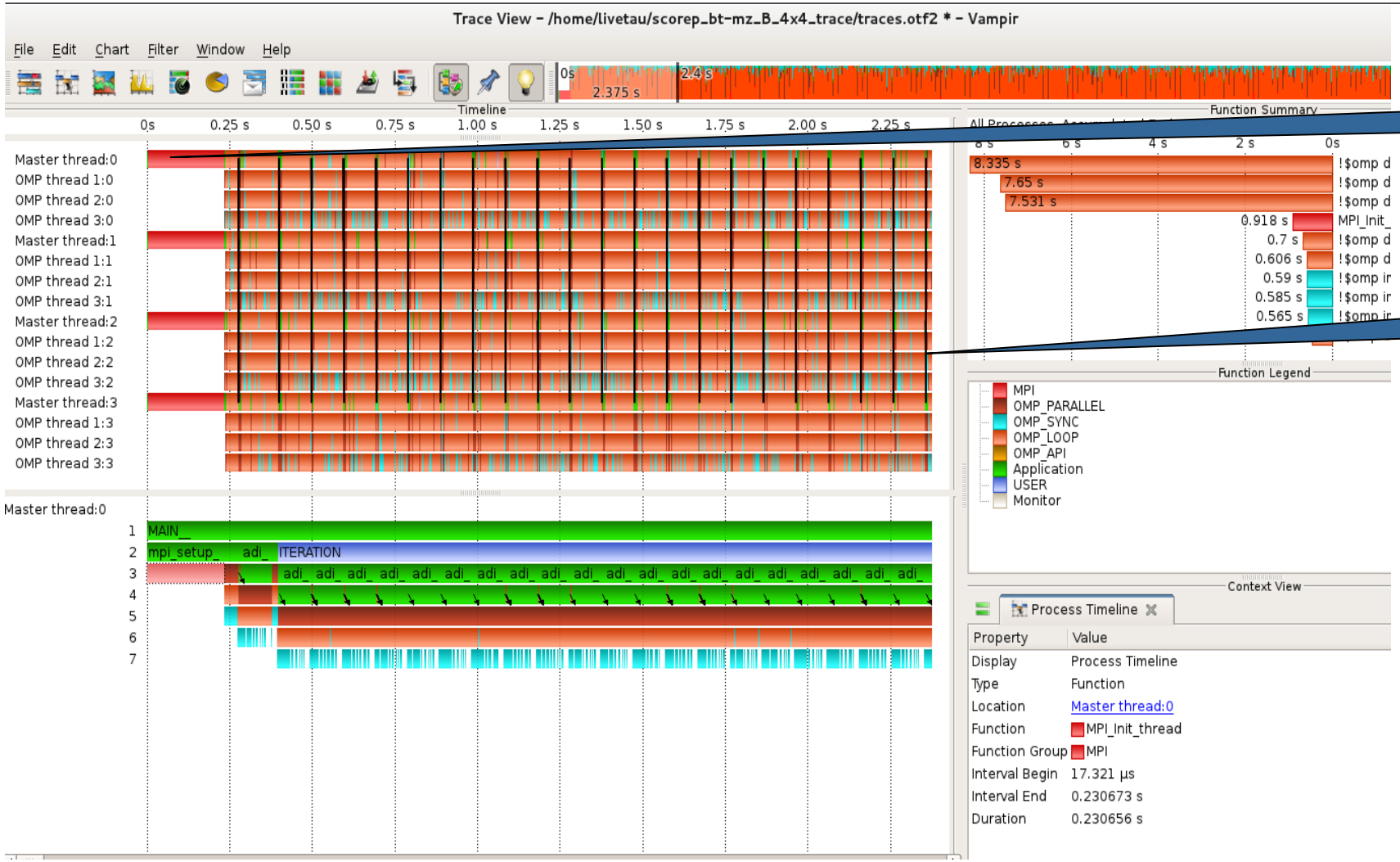

Detailed information about different levels of function calls in a stacked bar chart for an individual process

# Visualization of the NPB-MZ-MPI / BT trace
## Summary Timeline




Information about fraction of processes involved at a time-look for load imbalance

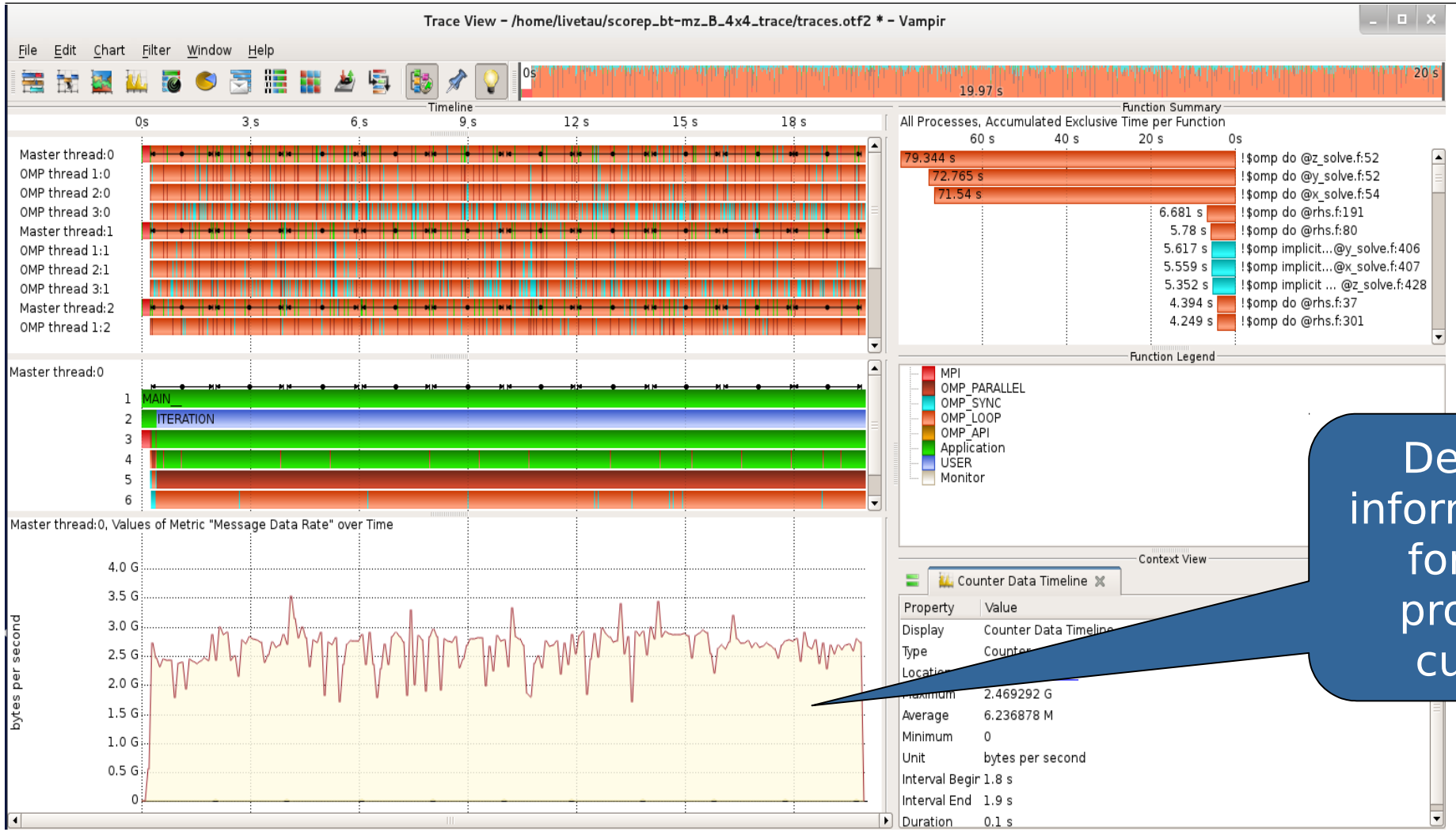
# Visualization of the NPB-MZ-MPI / BT trace
## Typical program phases




Initialization Phase

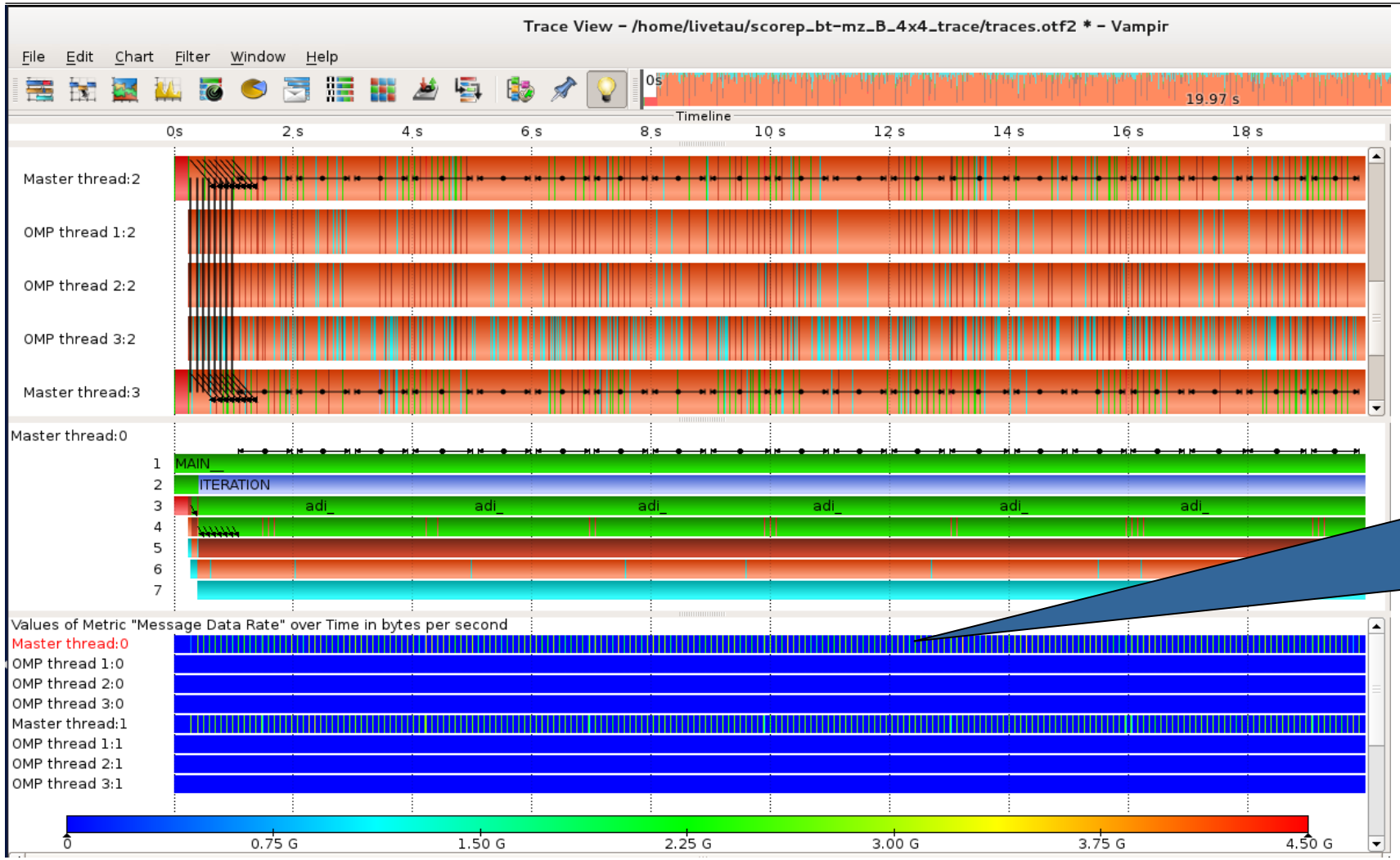
Computation Phase

# Visualization of the NPB-MZ-MPI / BT trace
## Counter Data Timeline




Detailed counter information over time for an individual process. Can see custom metrics

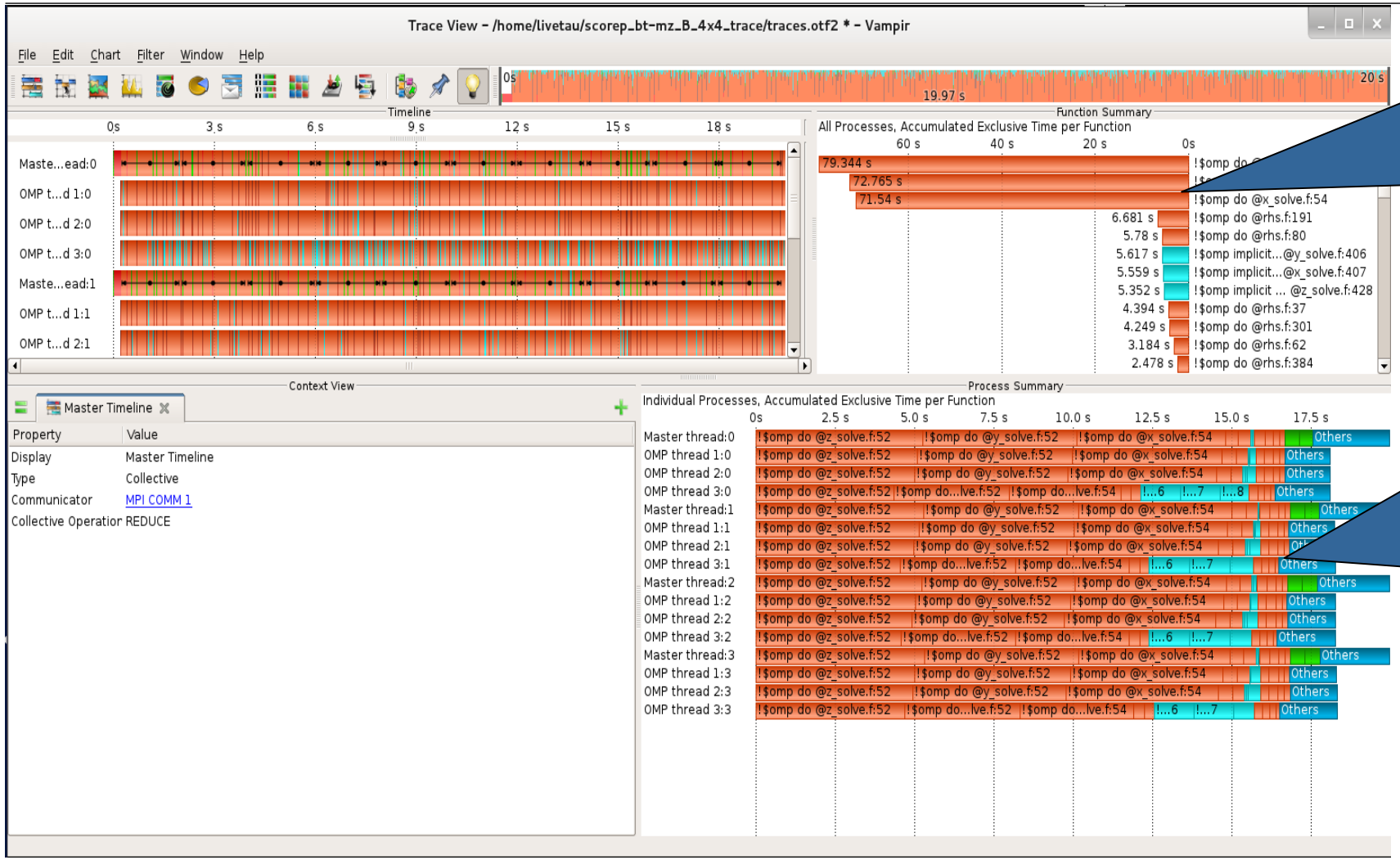
# Visualization of the NPB-MZ-MPI / BT trace
## Performance Radar




Detailed counter information over time for a collection of processes

# Additional Slides

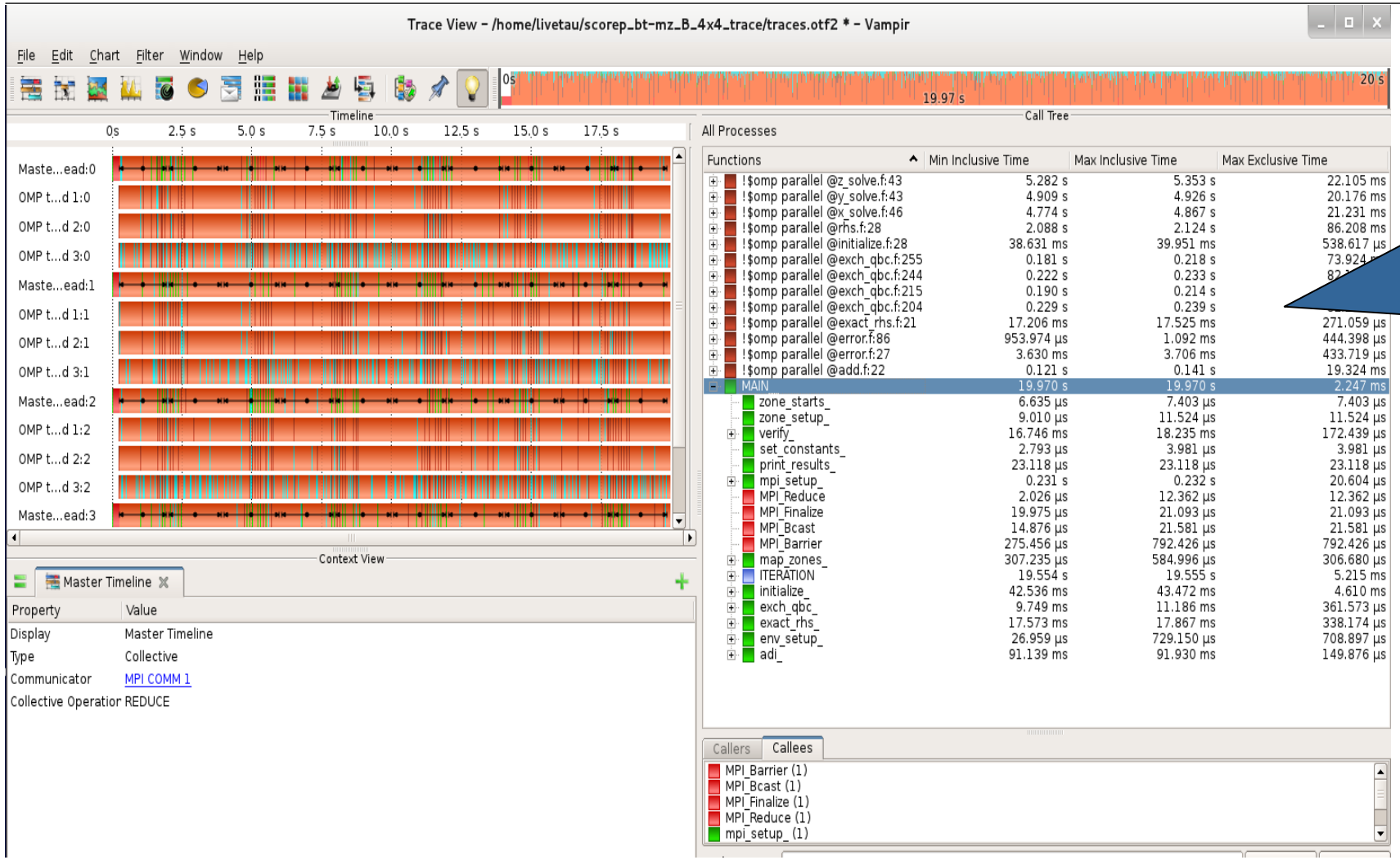
# Visualization of the NPB-MZ-MPI / BT trace
## Process Summary




**Function Summary:** Overview of the accumulated information across all functions and for a collection of processes

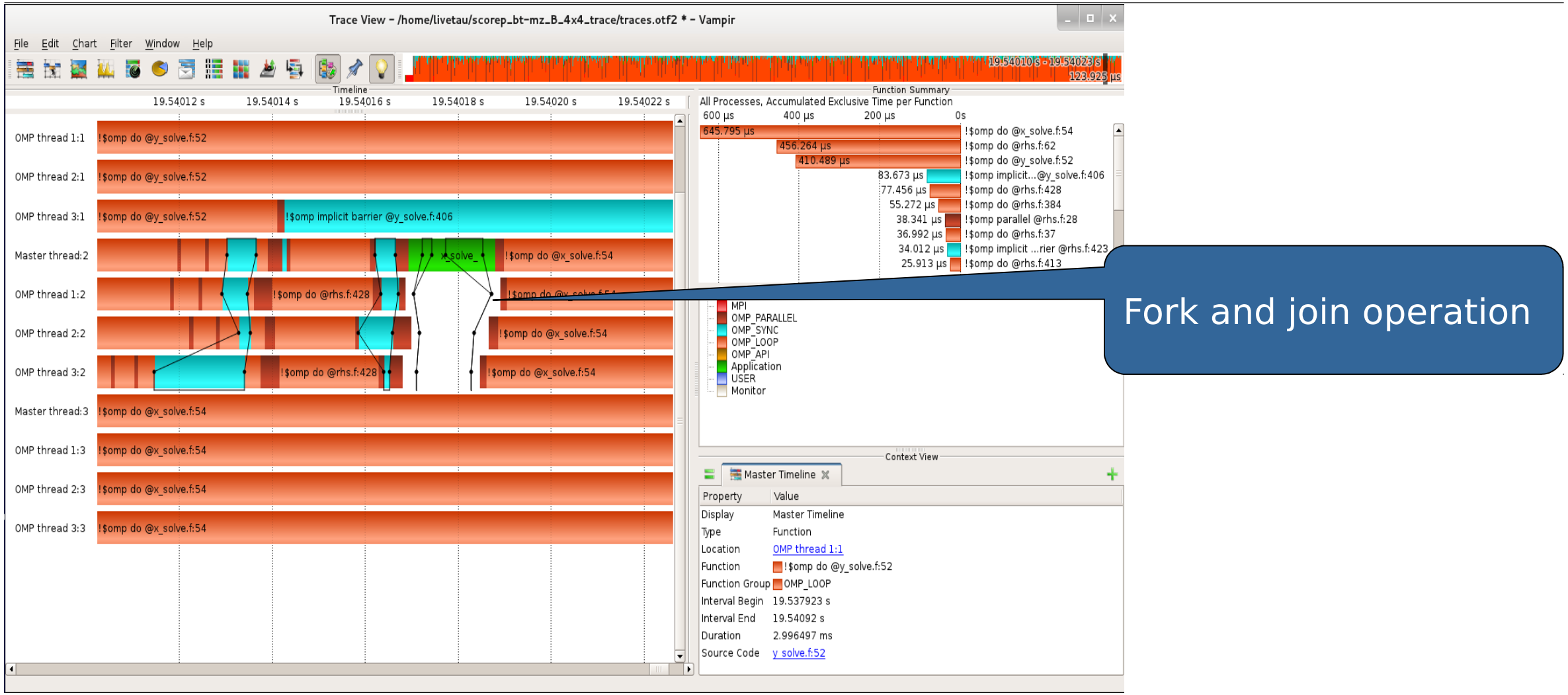
**Process Summary:** Overview of the accumulated information across all functions and for every process independently

# Visualization of the NPB-MZ-MPI / BT trace
## Call Tree Summary



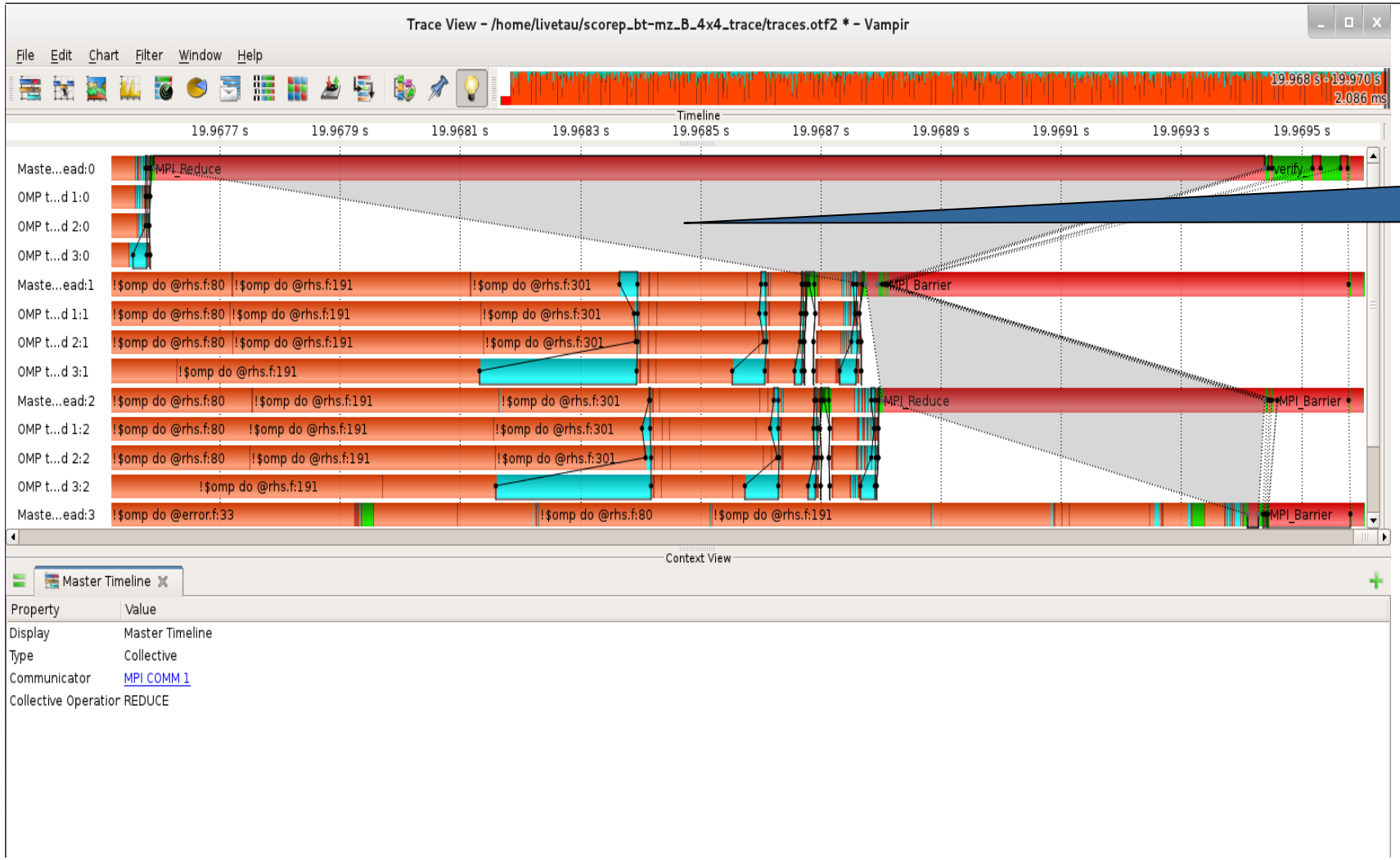

**Call Tree Summary:** Overview of the callers and callees across all functions

# Visualization of the NPB-MZ-MPI / BT trace
## Zoom in: Computation Phase




Fork and join operation

# Visualization of the NPB-MZ-MPI / BT trace
## Zoom in: Finalization Phase




"Early reduce" bottleneck

# Summary and Conclusion

# Summary

- Vampir & VampirServer
  - Interactive trace visualization and analysis
  - Intuitive browsing and zooming
  - Compare traces
  - Scalable to large trace data sizes (20 TiByte)
  - Scalable to high parallelism (200,000 processes)
- Vampir for Linux, Windows, and Mac OS X

- **Note:** Vampir neither solves your problems automatically, nor points you directly at them. It only gives you a full insight into the execution of your application.

Vampir is available at http://www.vampir.eu
Get support via vampirsupport@zih.tu-dresden.de