Performance Analysis with Vampir

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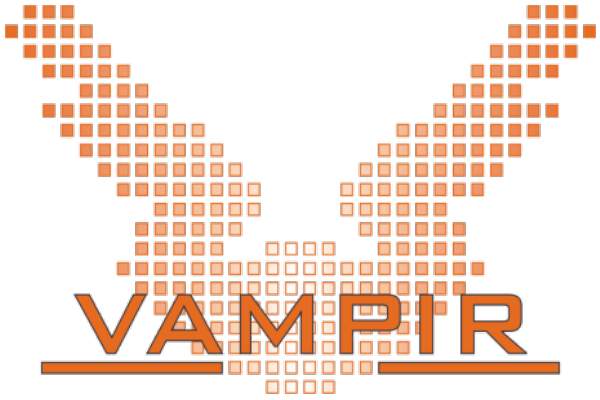
Part I: Welcome to the Vampir Tool Suite

- Mission
- Event Trace Visualization
- Vampir & VampirServer
- The Vampir Displays

Part II: Vampir Hands On

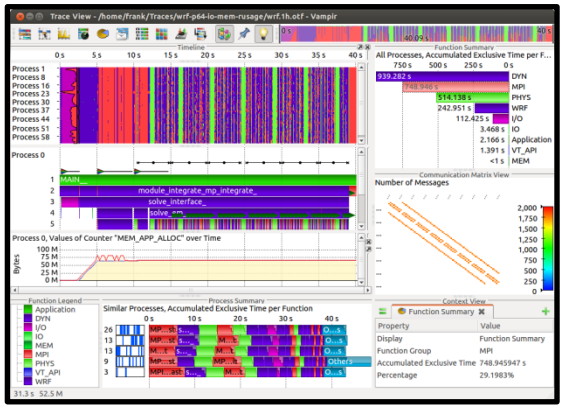
- Visualizing and analyzing NPB-MZ-MPI / BT

Part III: Summary and Conclusion



Mission

- Visualization of dynamics of complex parallel processes
- Requires two components
  - Monitor/Collector (Score-P)
  - Charts/Browser (Vampir)



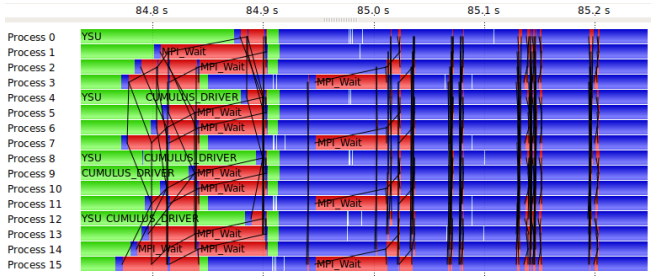
Typical questions that Vampir helps to answer:

- What happens in my application execution during a given time in a given process or thread?
- How do the communication patterns of my application execute on a real system?
- Are there any imbalances in computation, I/O or memory usage and how do they affect the parallel execution of my application?

- Alternative and supplement to automatic analysis
- Show dynamic run-time behavior graphically at any level of detail
- Provide statistics and performance metrics

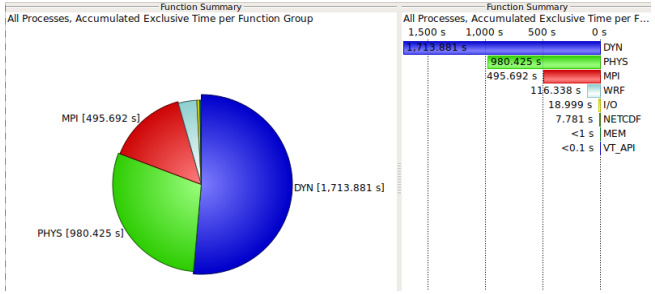
Timeline charts

– Show application activities and communication along a time axis



Summary charts

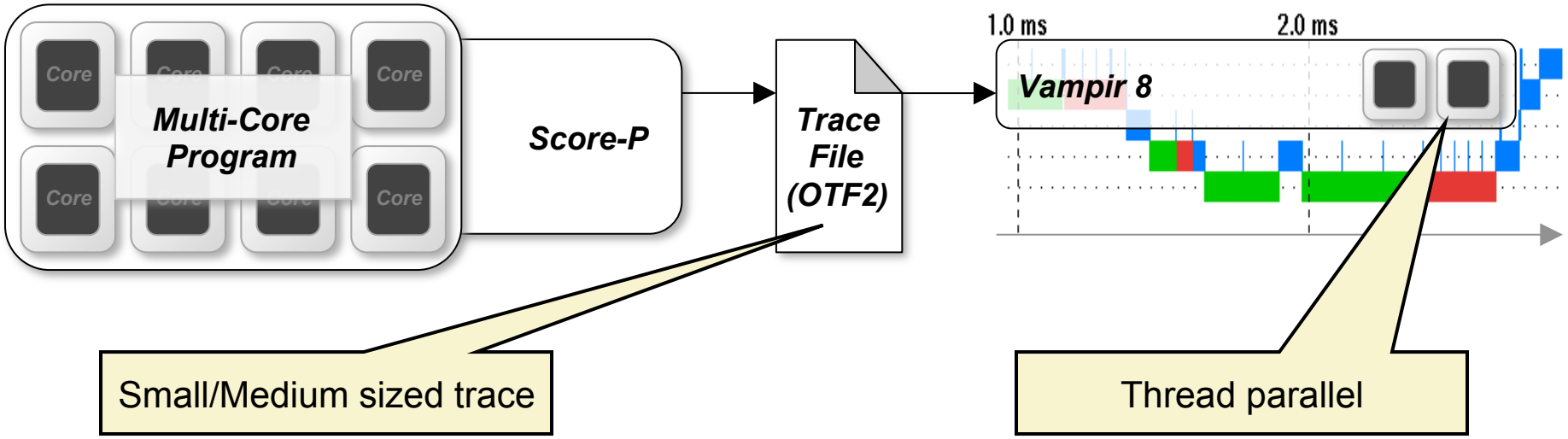
– Provide quantitative results for the currently selected time interval



Vampir – Visualization Modes (1)

- Directly on front end or local machine

```
% export MODULEPATH=
/zhome/academic/HLRS/xhp/xhprt/privatemodules:$MODULEPATH
% module load vampir
% vampir
```

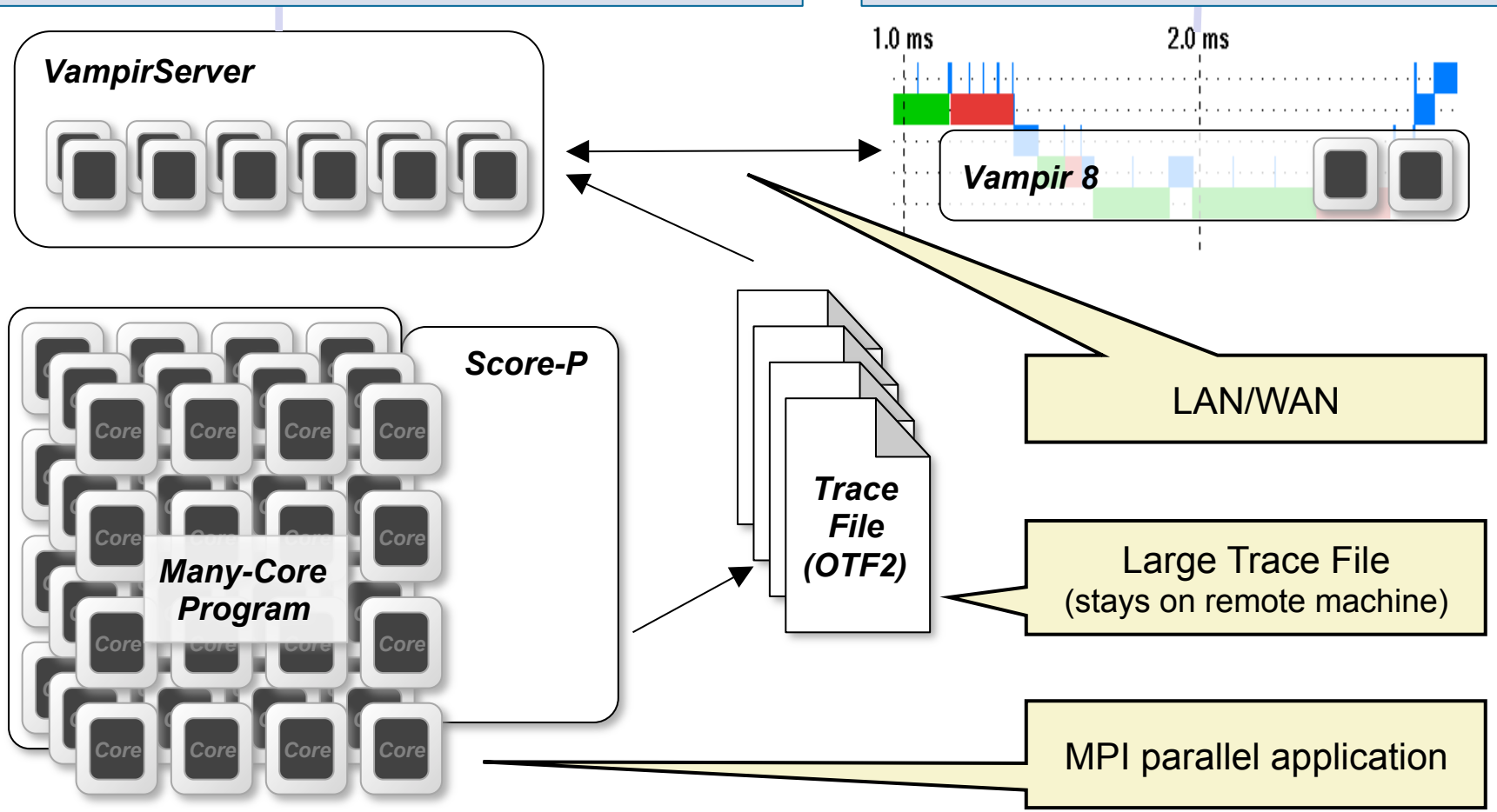


Vampir – Visualization Modes (2)

- On local machine with remote VampirServer

```
% module load vampirserver
% vampirserver start
```

```
% module load vampir
% vampir
```



Usage order of the Vampir Performance Analysis Toolset

1. Instrument your application with Score-P

2. Run your application with an appropriate test set

3. Analyze your trace file with Vampir
   - Small trace files can be analyzed on your local workstation
     1. Start your local Vampir
     2. Load trace file from your local disk
   - Large trace files should be stored on the HPC file system
     1. Start VampirServer on your HPC system
     2. Start your local Vampir
     3. Connect local Vampir with the VampirServer on the HPC system
     4. Load trace file from the HPC file system

The main displays of Vampir

- **Timeline Charts:**
  -  Master Timeline
  -  Process Timeline
  -  Counter Data Timeline
  -  Performance Radar
- **Summary Charts:**
  -  Function Summary
  -  Message Summary
  -  Process Summary
  -  Communication Matrix View

Vampir hands-on

Visualizing and analyzing NPB-MZ-MPI / BT

Help! Where is my trace file?

- If you followed the Score-P hands-on up to the trace experiment, yours is in:

```
% ls $SCRATCH/NPB3.3-MZ-MPI/bin.scorep/scorep_trace
profile.cubex  scorep.cfg    traces/   traces.def  traces.otf2
```

That's what you will open with Vampir

- If you removed the trace or did not follow to that point, copy a prepared trace

```
% cd $SCRATCH/NPB3.3-MZ-MPI/bin.scorep
% cp /zhome/academic/HLRS/xhp/xhprt/scorep_trace ./
```

Option A: Starting Vampir on Hornet

- Load modules

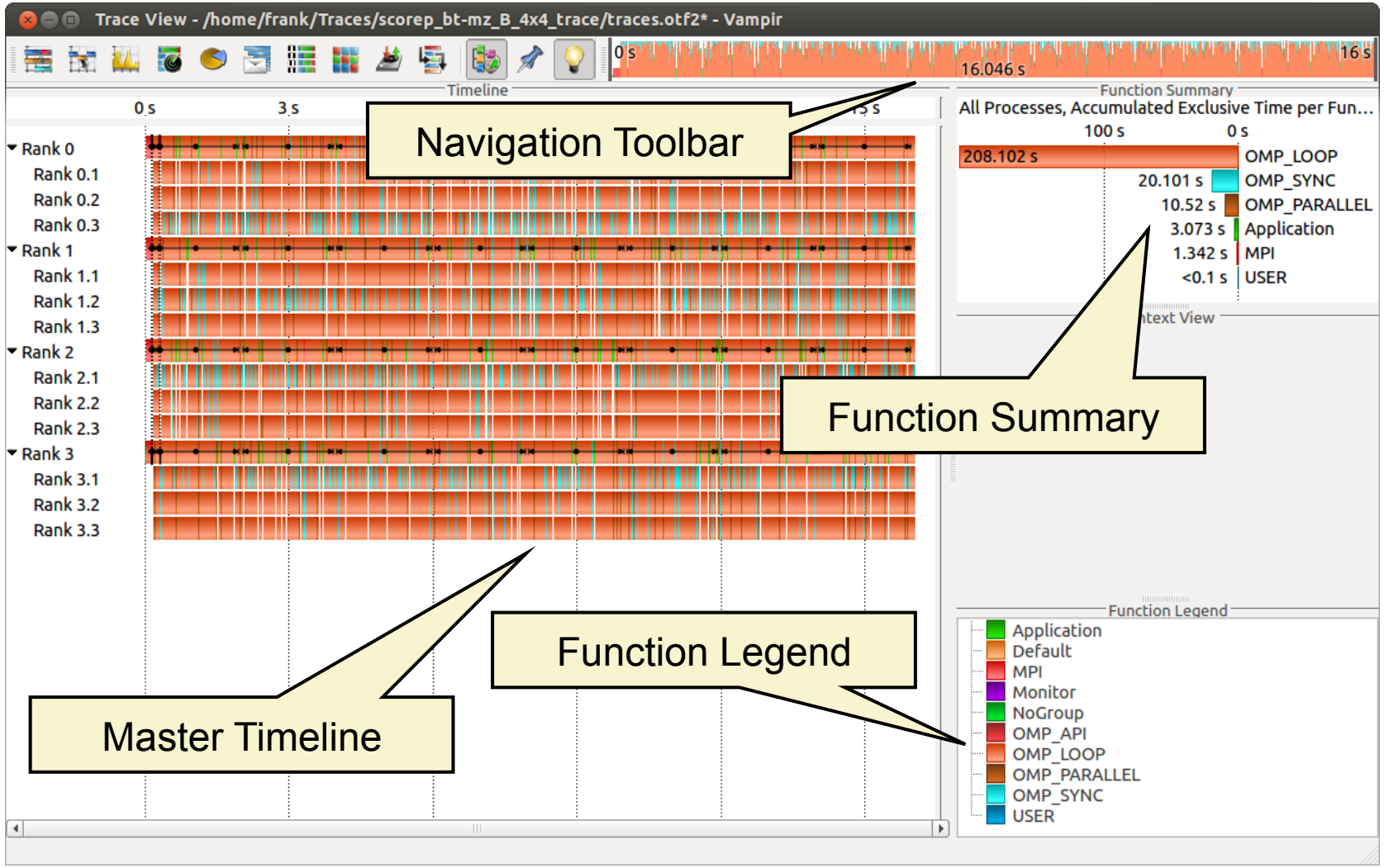
```
% export MODULEPATH=
/zhome/academic/HLRS/xhp/xhprt/privatemodules:$MODULEPATH
% module load vampir
```

- Start Vampir on the frontend (small traces only!)

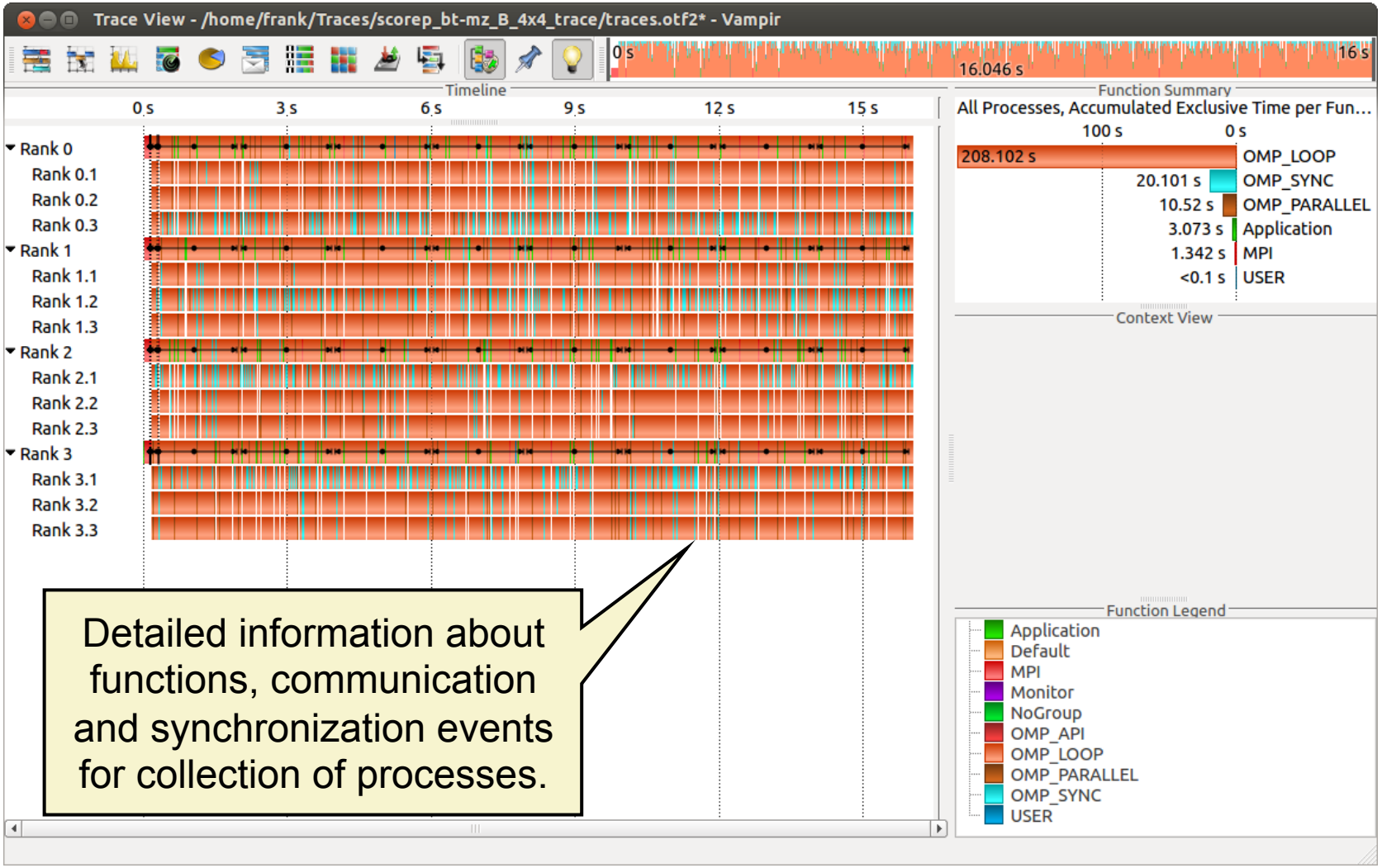
```
% vampir
```

- Use the following to connect to Hornet:
  $ **ssh –XC …**
- This enables X11 forwarding AND compression, the latter is very helpful for a good usage experience

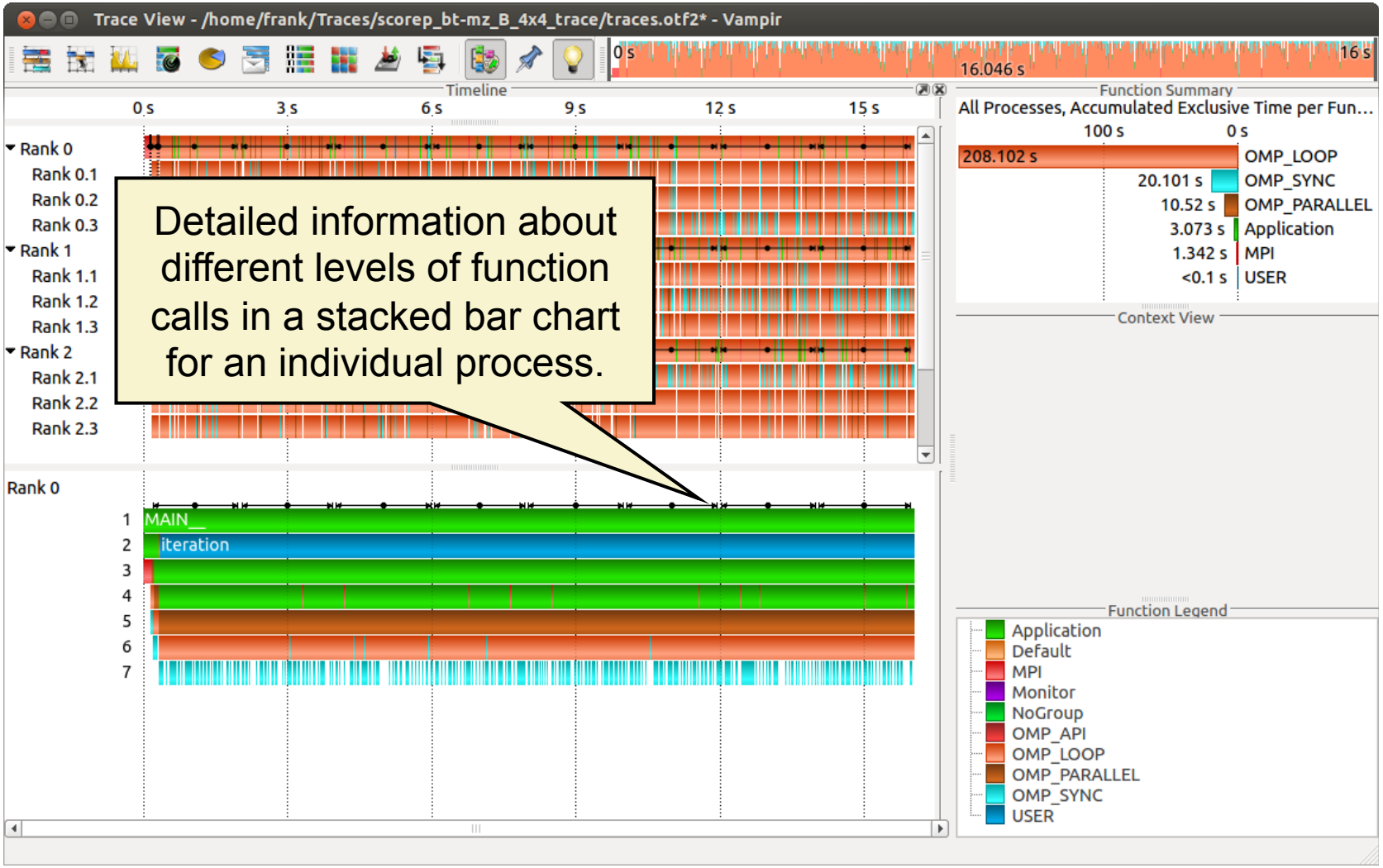
Vampir: Visualization of the NPB-MZ-MPI / BT trace



Master Timeline

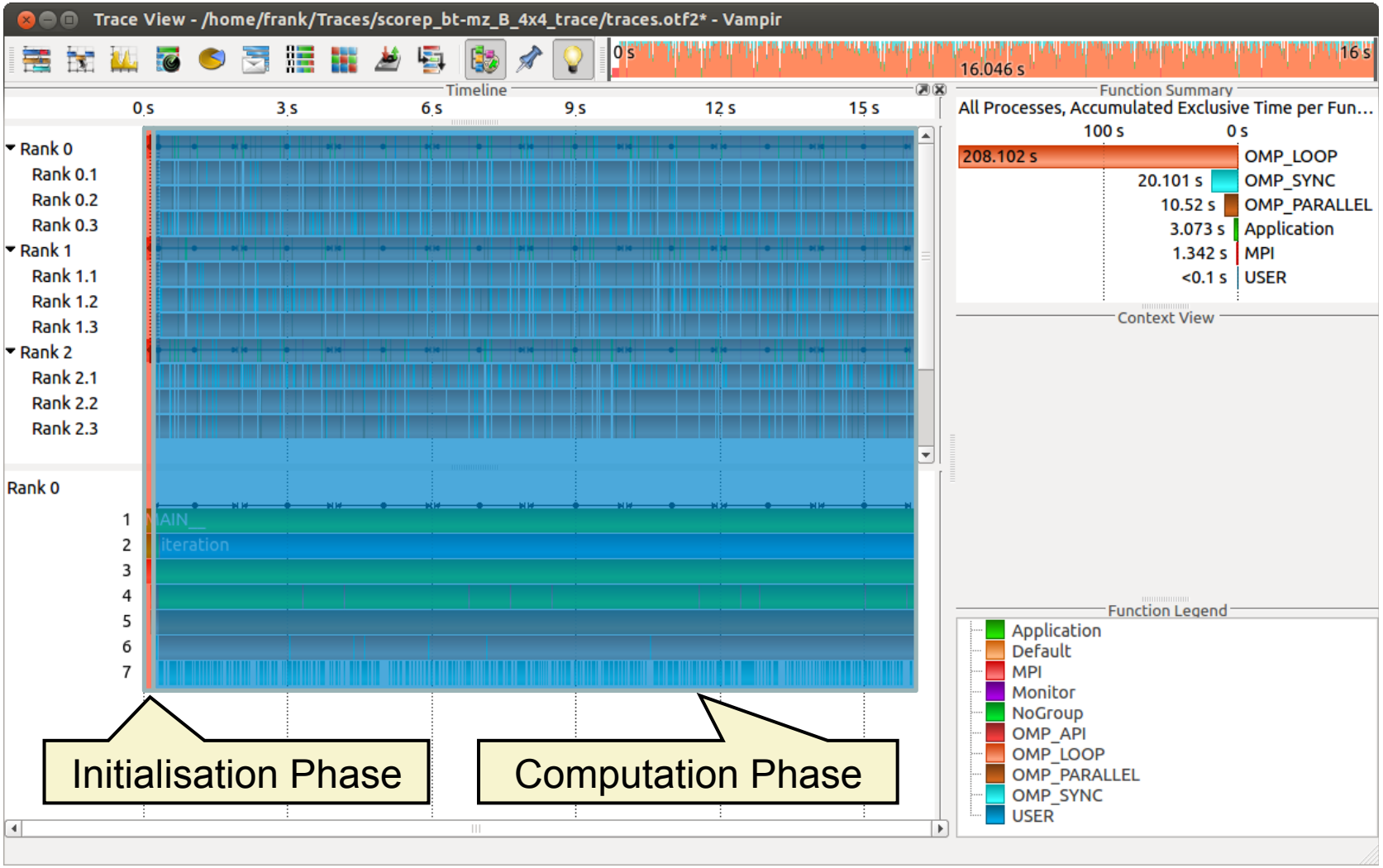


Process Timeline



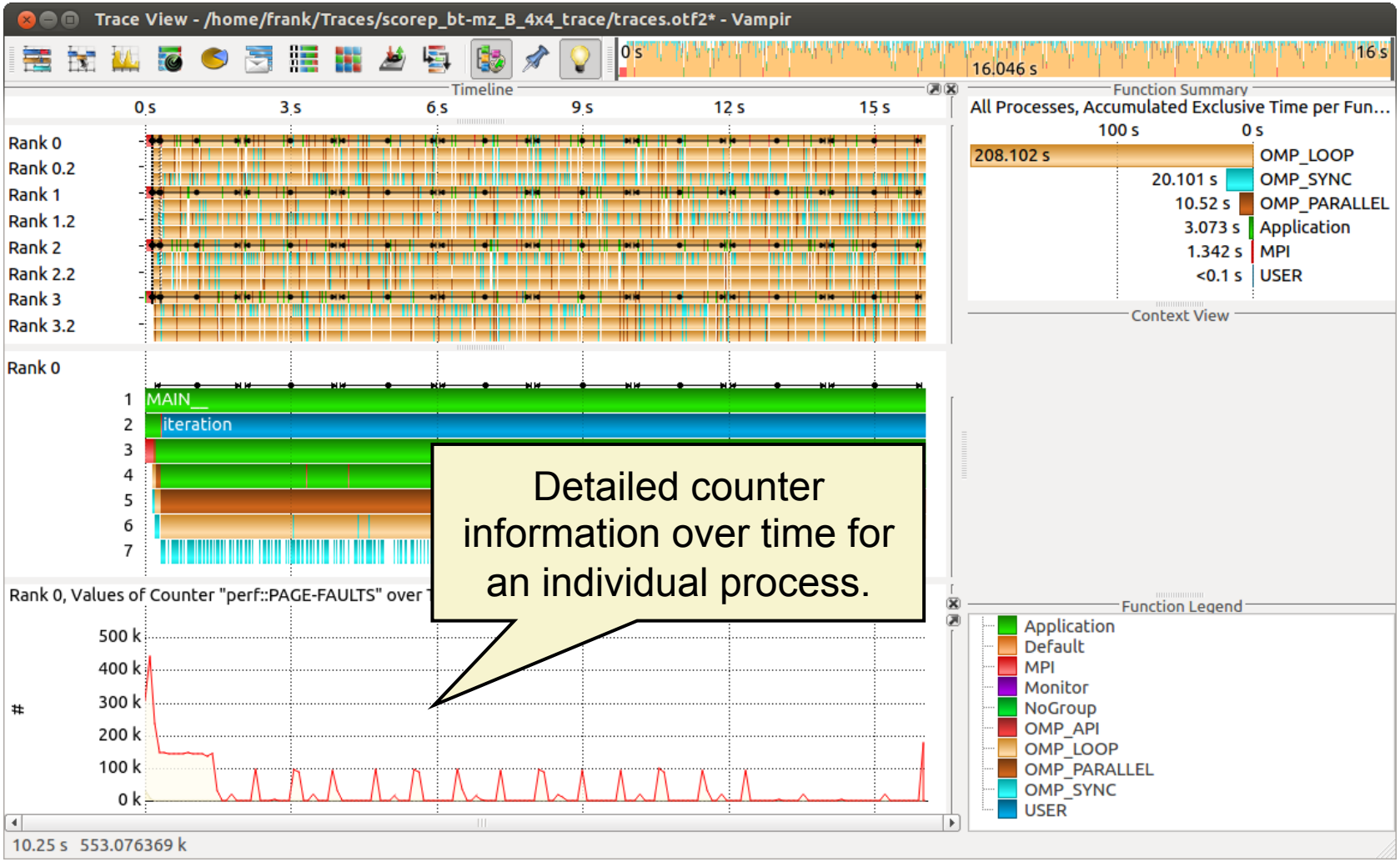
Vampir: Visualization of the NPB-MZ-MPI / BT trace

Typical program phases



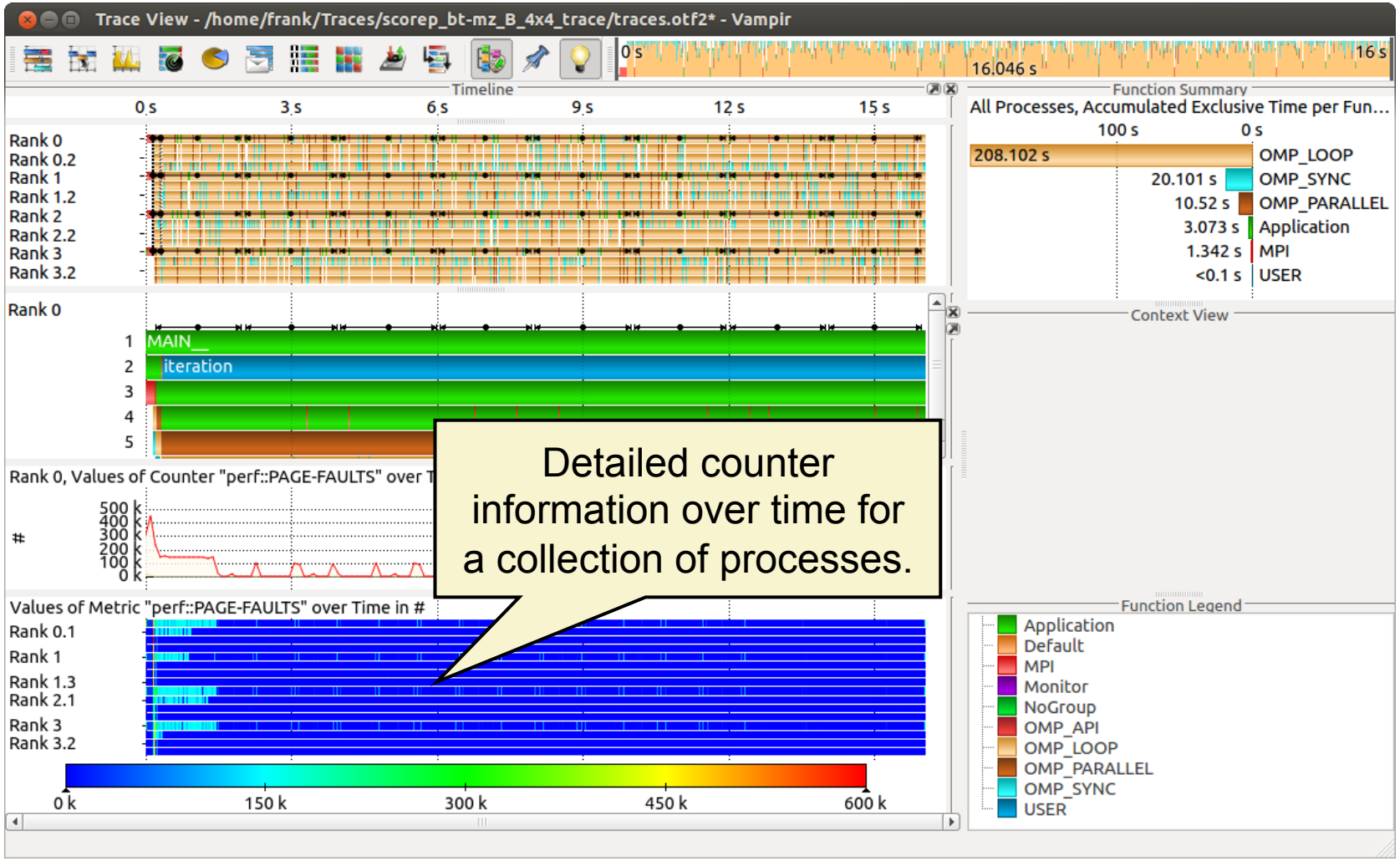
Vampir: Visualization of the NPB-MZ-MPI / BT trace

Counter Data Timeline

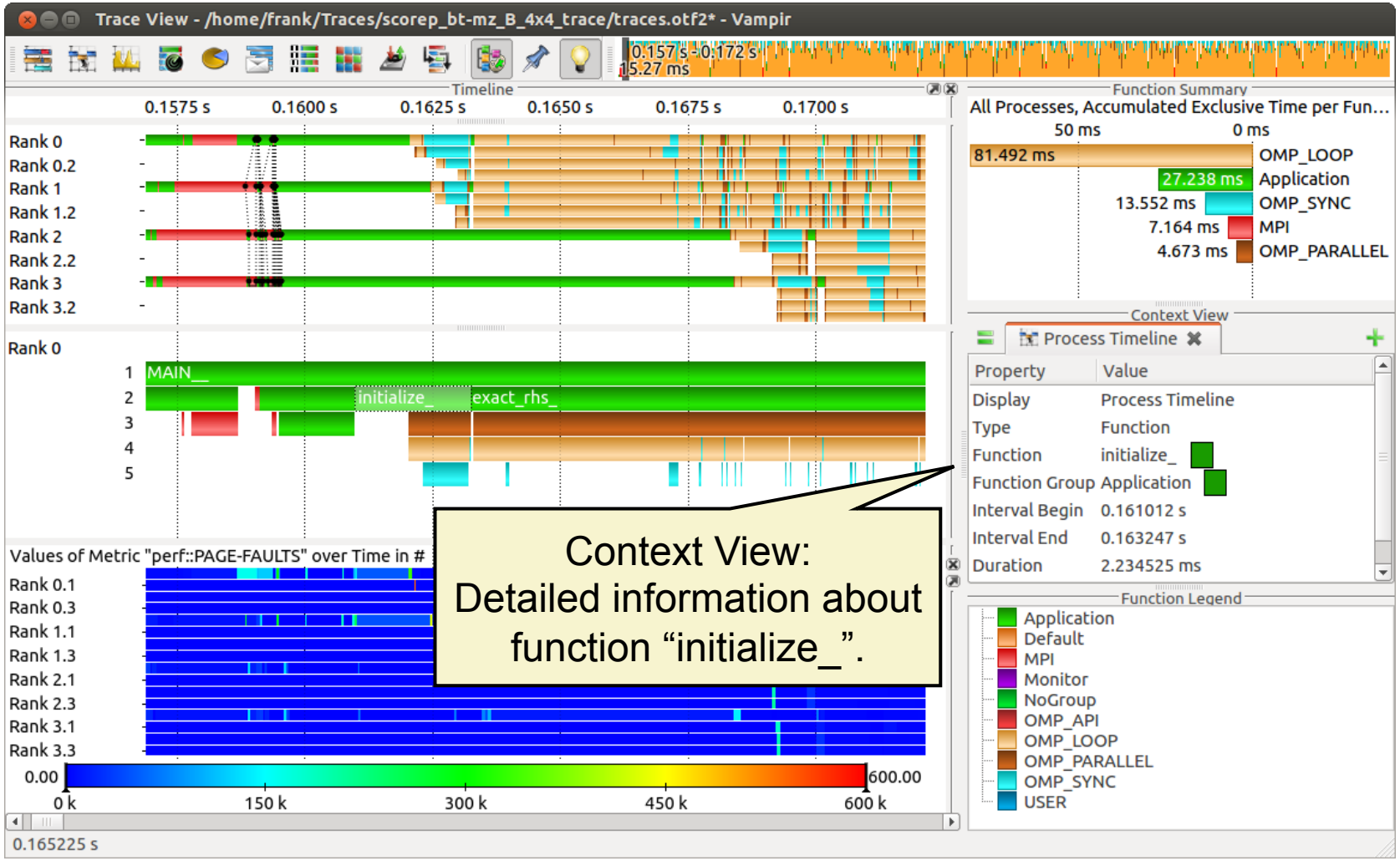


Vampir: Visualization of the NPB-MZ-MPI / BT trace

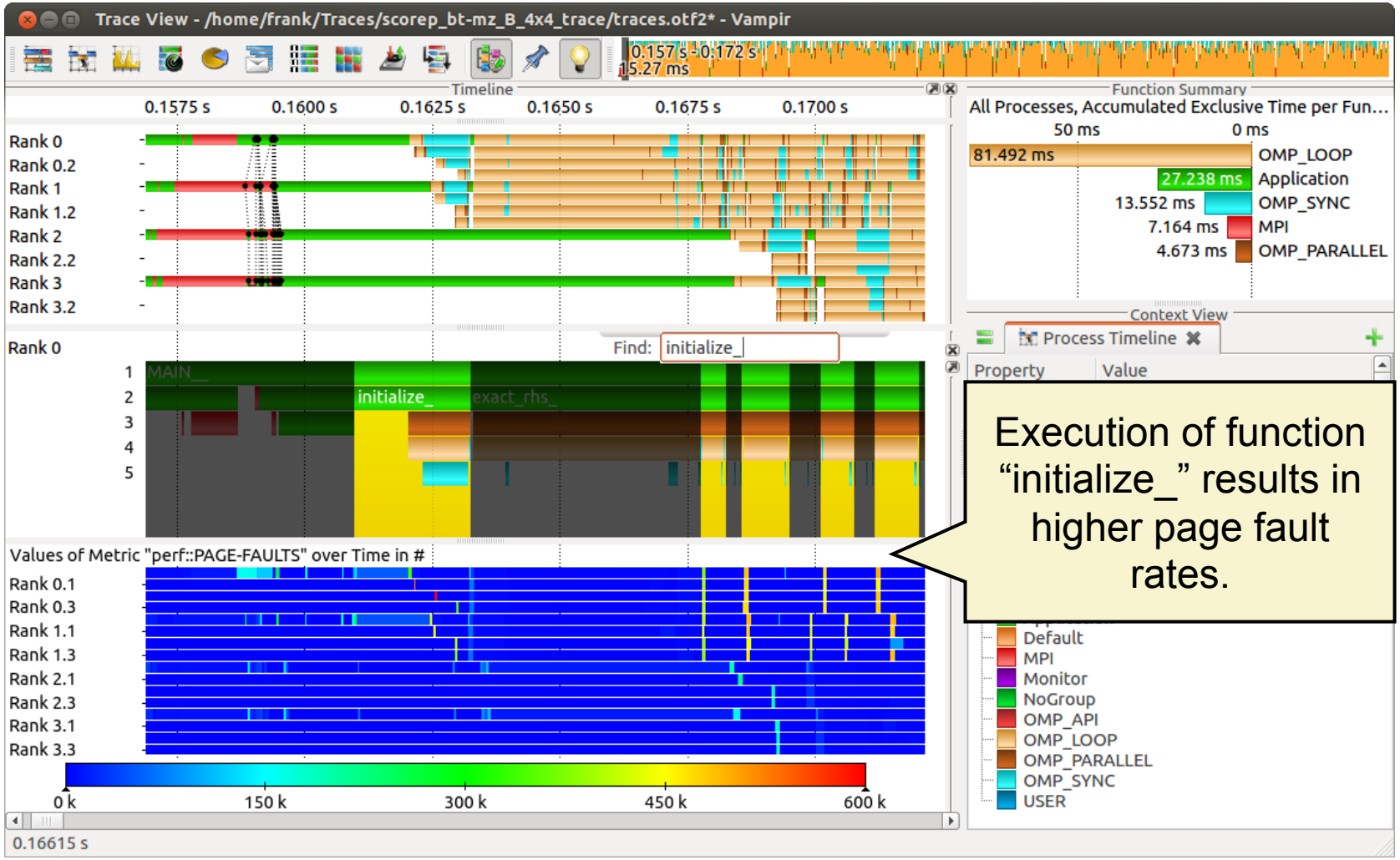
Performance Radar



Zoom in: Inititialisation Phase

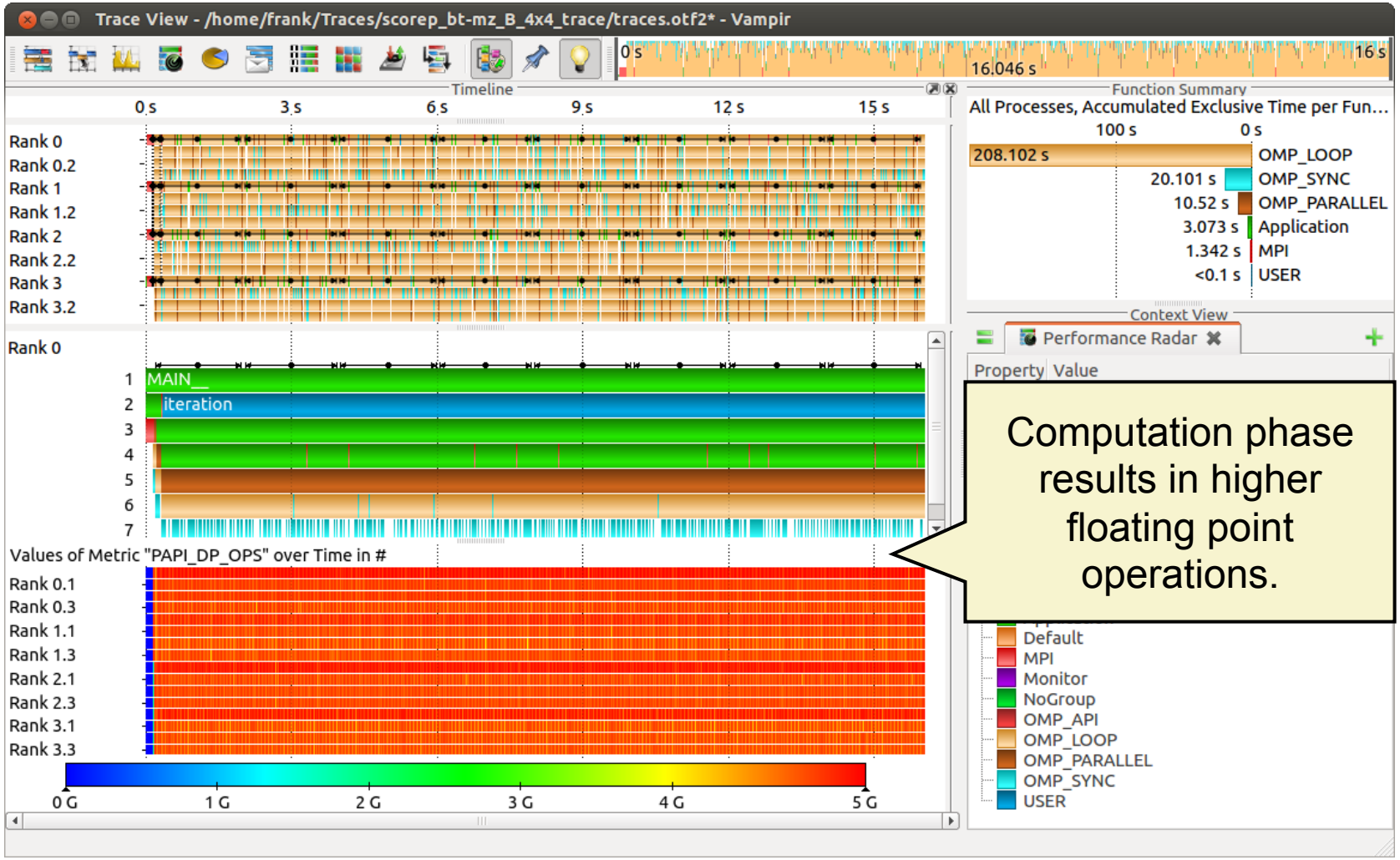


Feature: Find Function

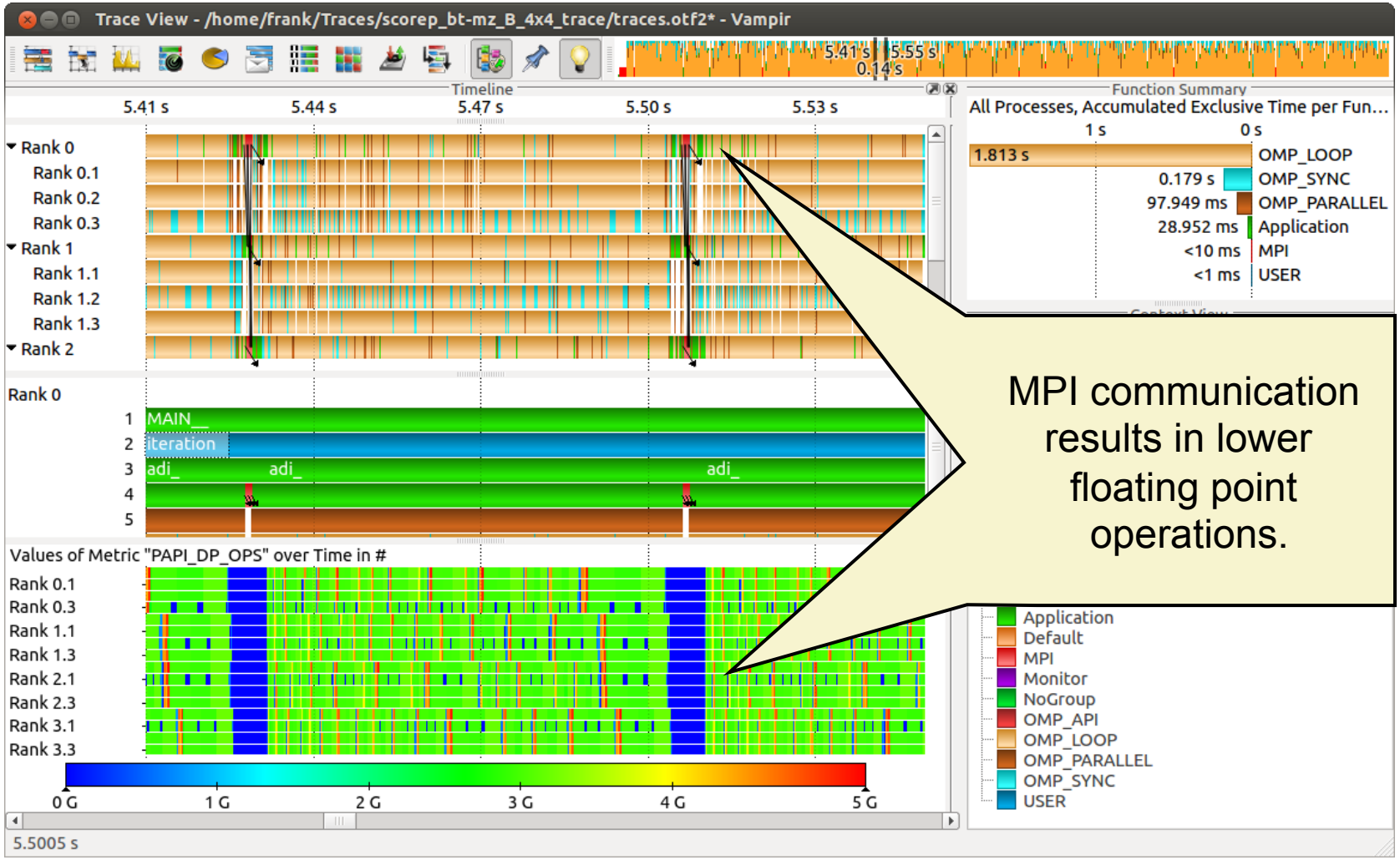


Execution of function “initialize_” results in higher page fault rates.

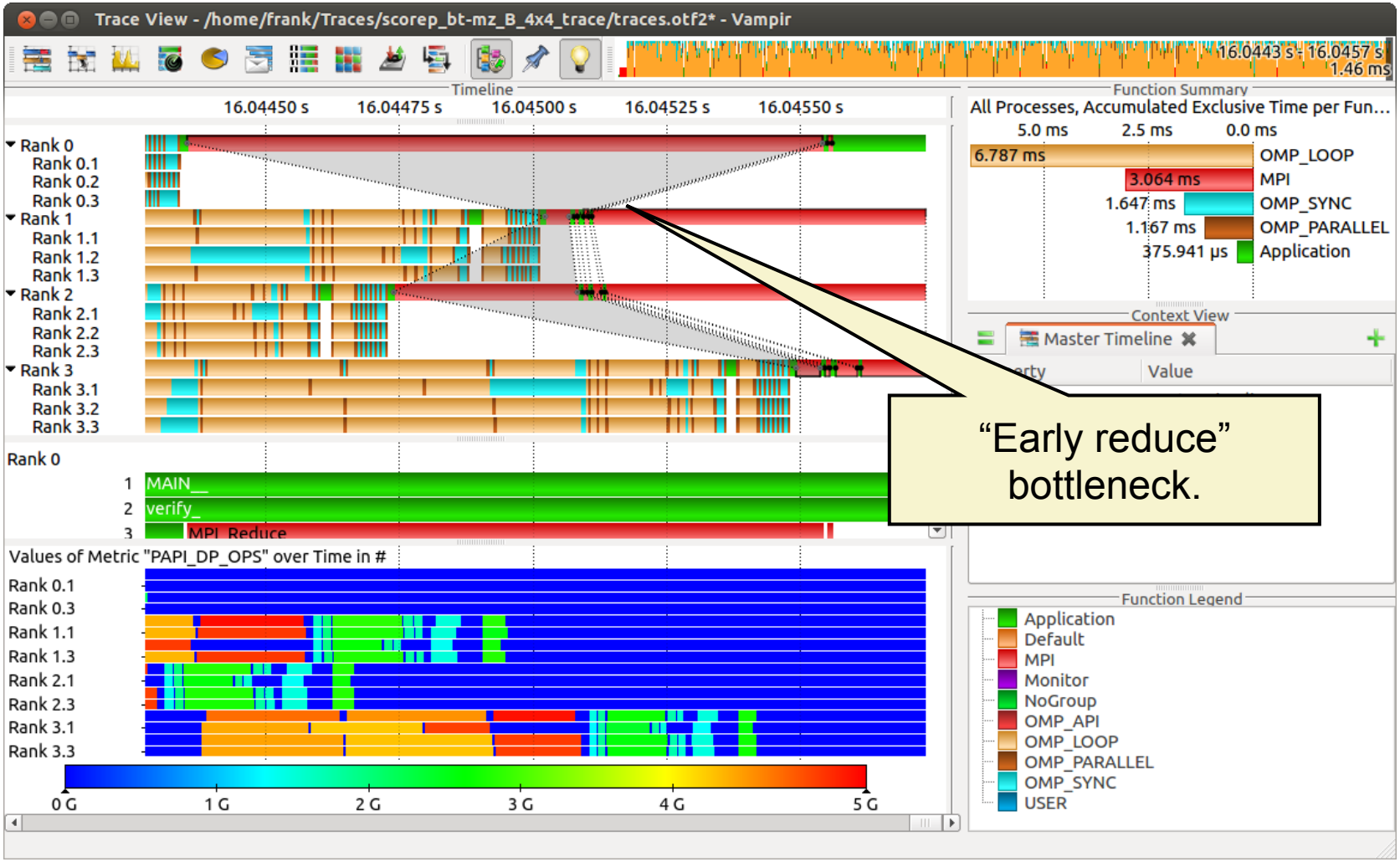
Computation Phase



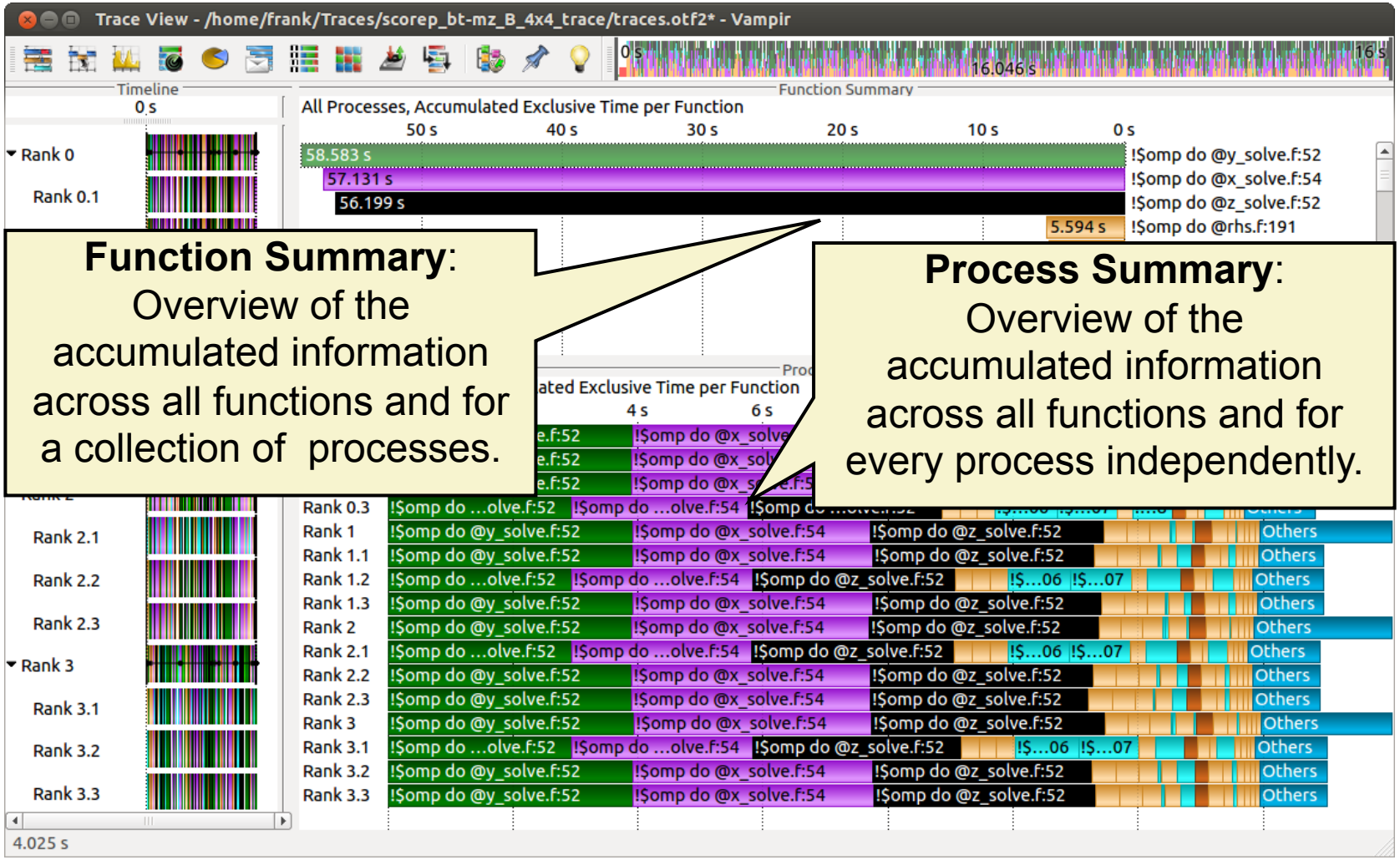
Zoom in: Computation Phase



Zoom in: Finalisation Phase



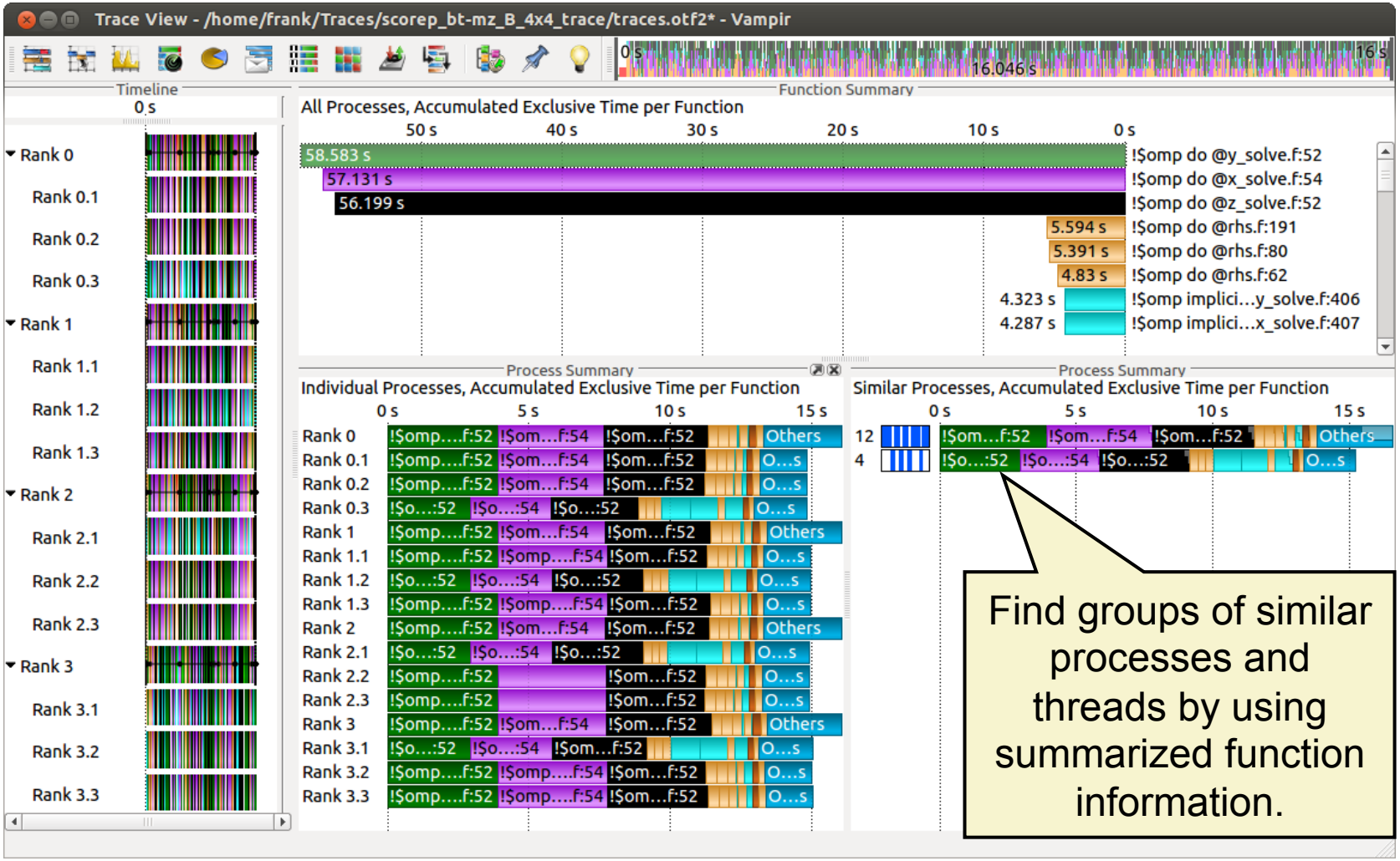
Process Summary



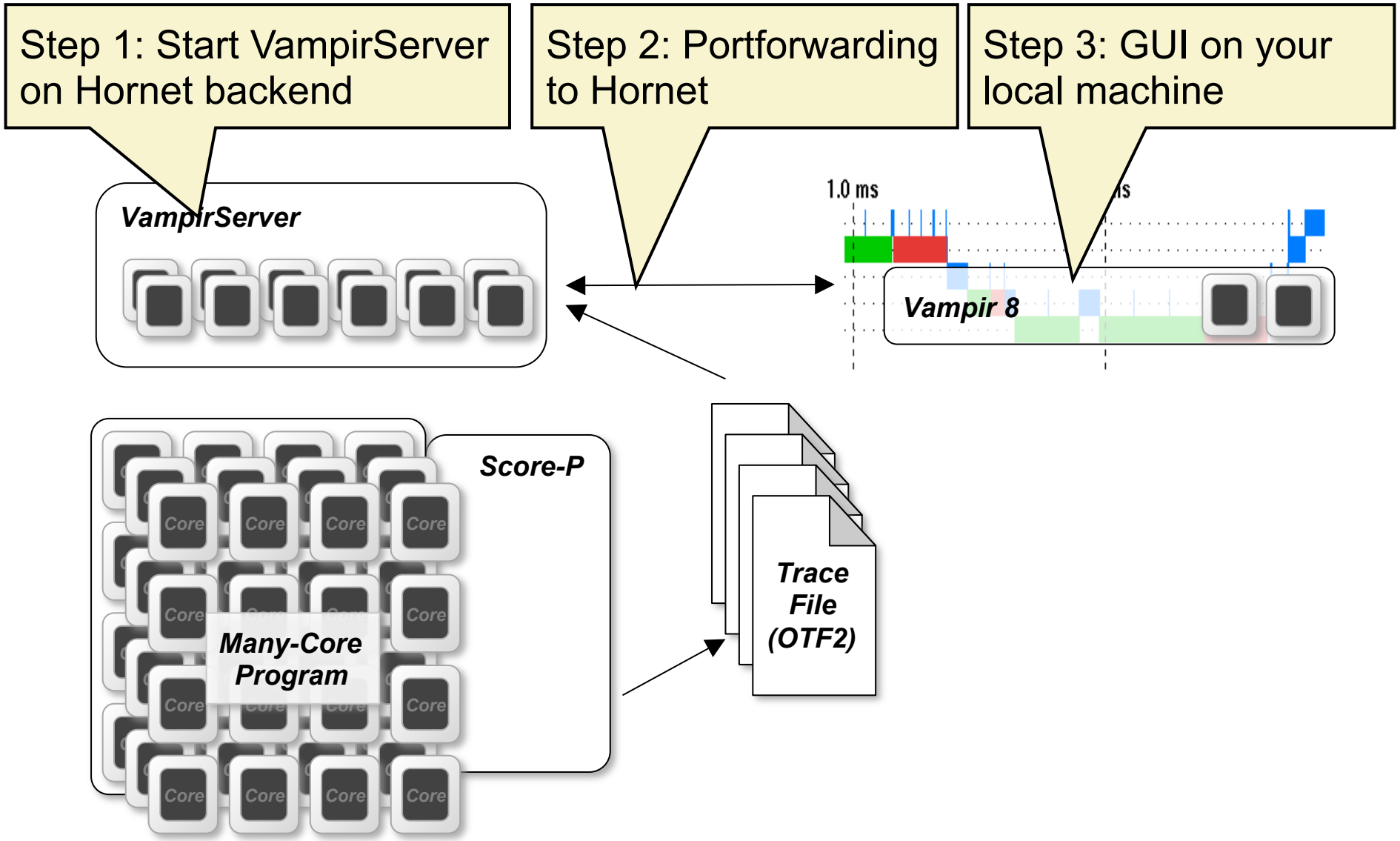
Function Summary: Overview of the accumulated information across all functions and for a collection of processes.

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

Process Summary



Option B: Larger Traces – Overview



Option B: Step 1, Starting Vampirserver on Hornet

- Load modules

```
% export MODULEPATH=
    /zhome/academic/HLRS/xhp/xhprt/privatemodules:$MODULEPATH
% module load vampirserver
```

- Start a vampirserver job on the backend

```
% vampirserver start
Launching VampirServer...
Submitting PBS batch job (this might take a while)...
Batch job is submitted - Job ID: 168008.hornet-batch.hww.de
VampirServer 8.4.1  (r9456)
Licensed to VI-HPS Tools Workshop 02/2015
Running 16 analysis processes... (abort with vampirserver stop 23731)
VampirServer <23731> listens on: mom12:30081
```

Remember these coordinates we will need them in a second

Option B: Step 2, Port Forwarding to Hornet

- Write down the host on which the server runs

```
% vampirserver start
Launching VampirServer...
Submitting PBS batch job (this might take a while)...
Batch job is submitted - Job ID: 168008.hornet-batch.hww.de
VampirServer 8.4.1  (r9456)
Licensed to VI-HPS Tools Workshop 02/2015
Running 16 analysis processes... (abort with vampirserver stop 23731)
VampirServer <23731> listens on: mom12:30081
```

- Establish Port Forwarding from your local machine to Hornet

```
% ssh \
    -L 30000:mom12:30081 \
    <user>@hornet.hww.de
```

Option B: Step 2, Install Vampir client locally

- Start a new shell on you laptop
- Copy the appropriate Vampir package from Hornet to your laptop

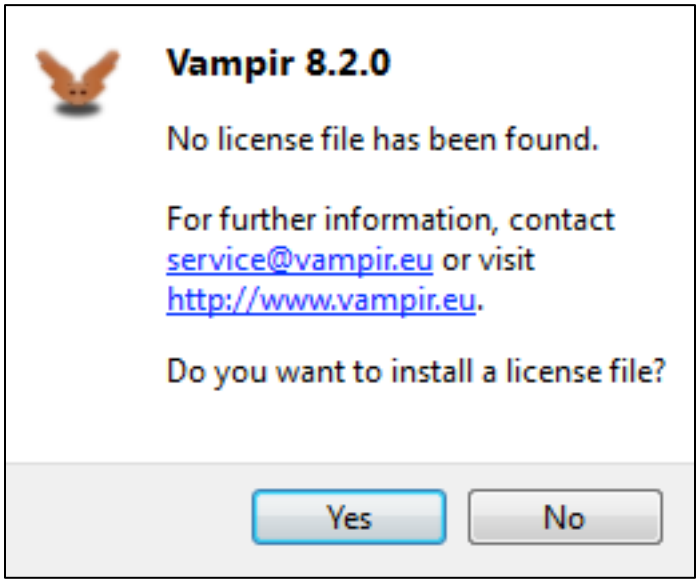
```
% ls /zhome/academic/HLRS/xhp/xhprt/tutorial
vampir-linux-ia32.zip    vampir-win-x64.zip     vampir-linux-x86_64.zip
vampir-win-x86.zip       vampir-mac.zip
% scp <user>@hornet.hww.de:/zhome/academic/HLRS/xhp/xhprt/tutorial/<version> ./
```

- Extract the archive and install (example with linux-x86-64)

```
% unzip vampir-linux-x86_64.zip
% cd vampir-linux-x86_64
% ls
vampir-8.4.1-linux-x86_64-setup.bin
vampir-remote.license
```

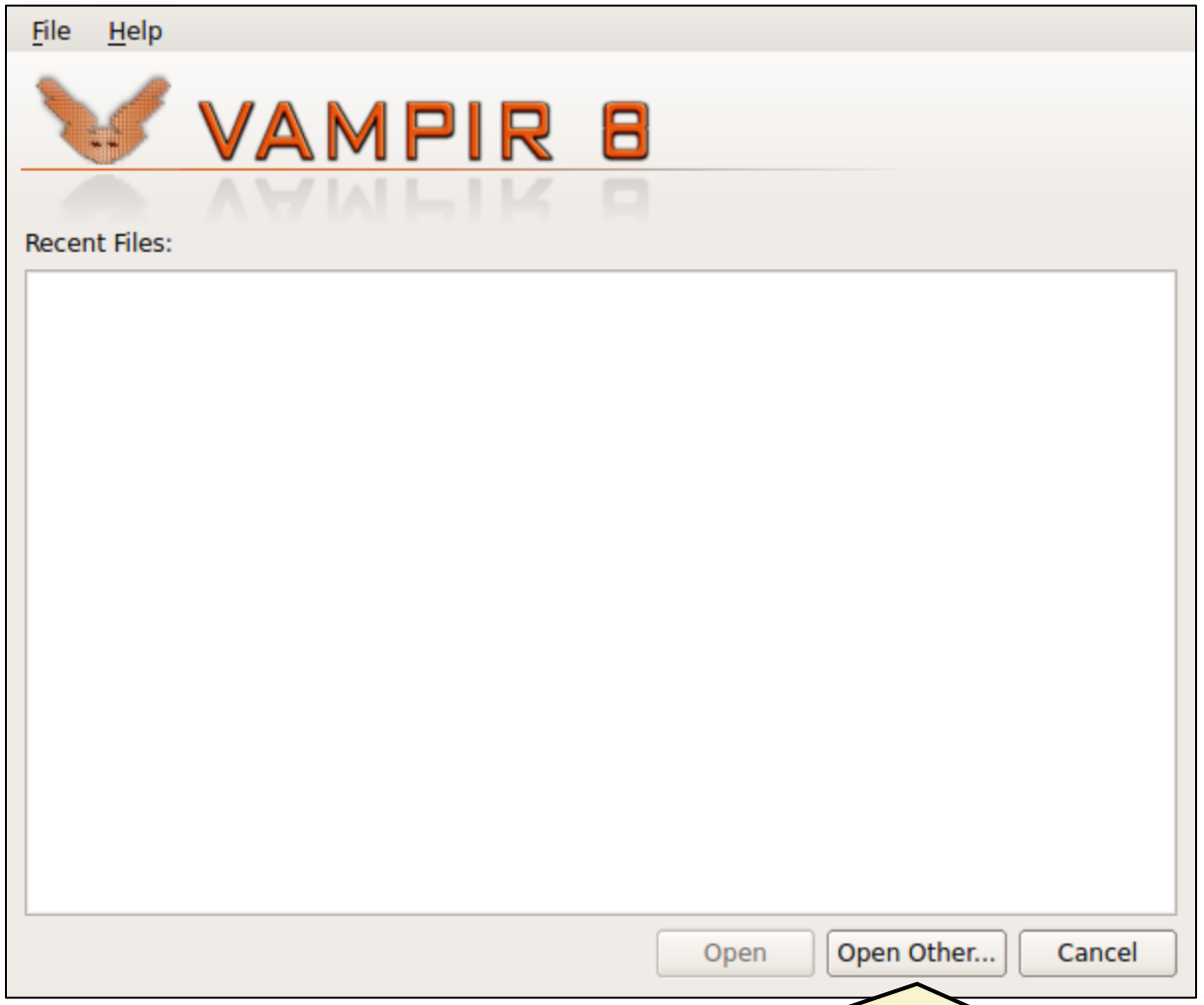
- Install and start the Vampir GUI

Option B: Step 2, Install Vampir client locally



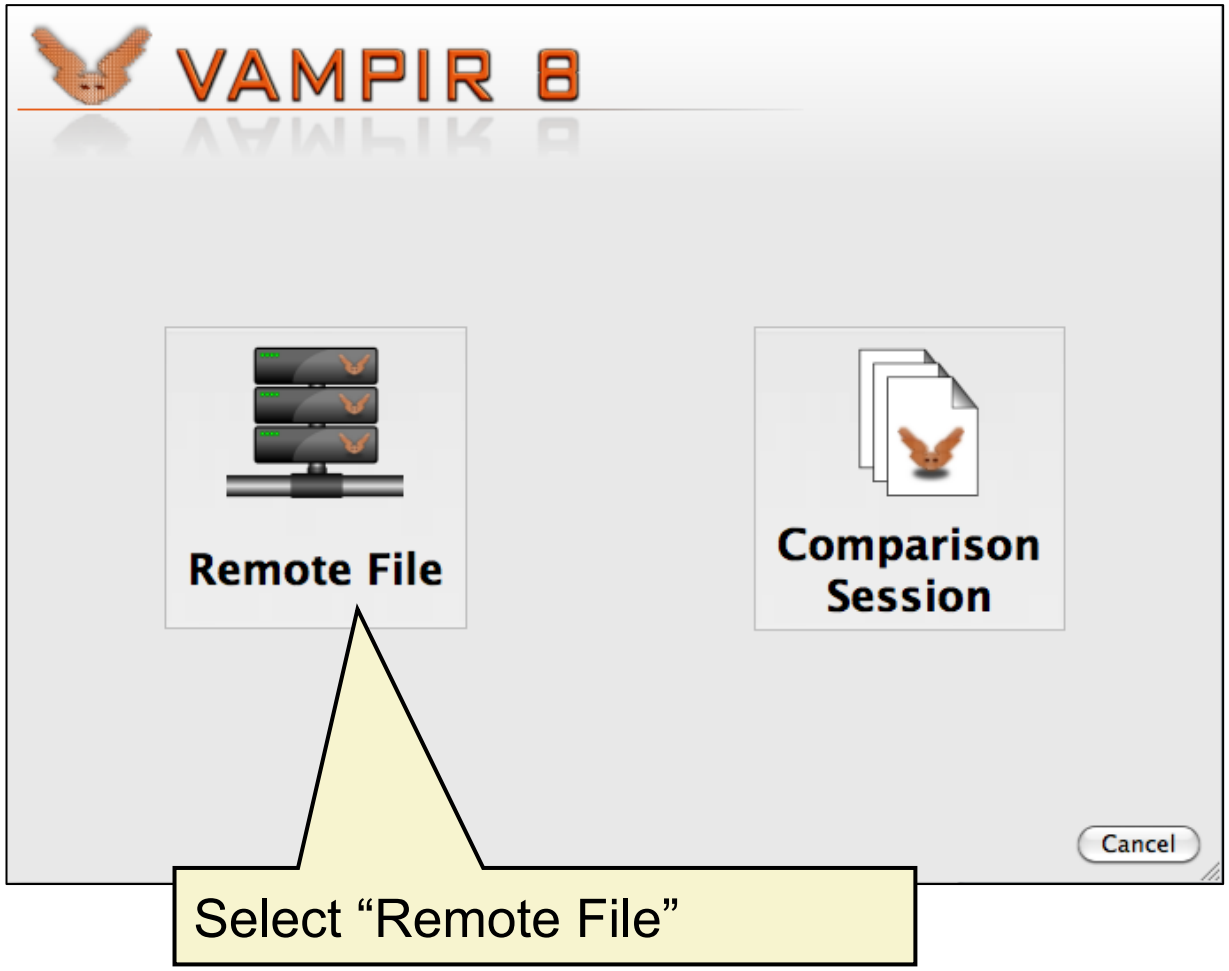
- Select the vampir-remote.licence from the archive file when asked

Option B: Step 2, Install Vampir client locally



Use the “Open Other” option

Option B: Step 2, Install Vampir client locally



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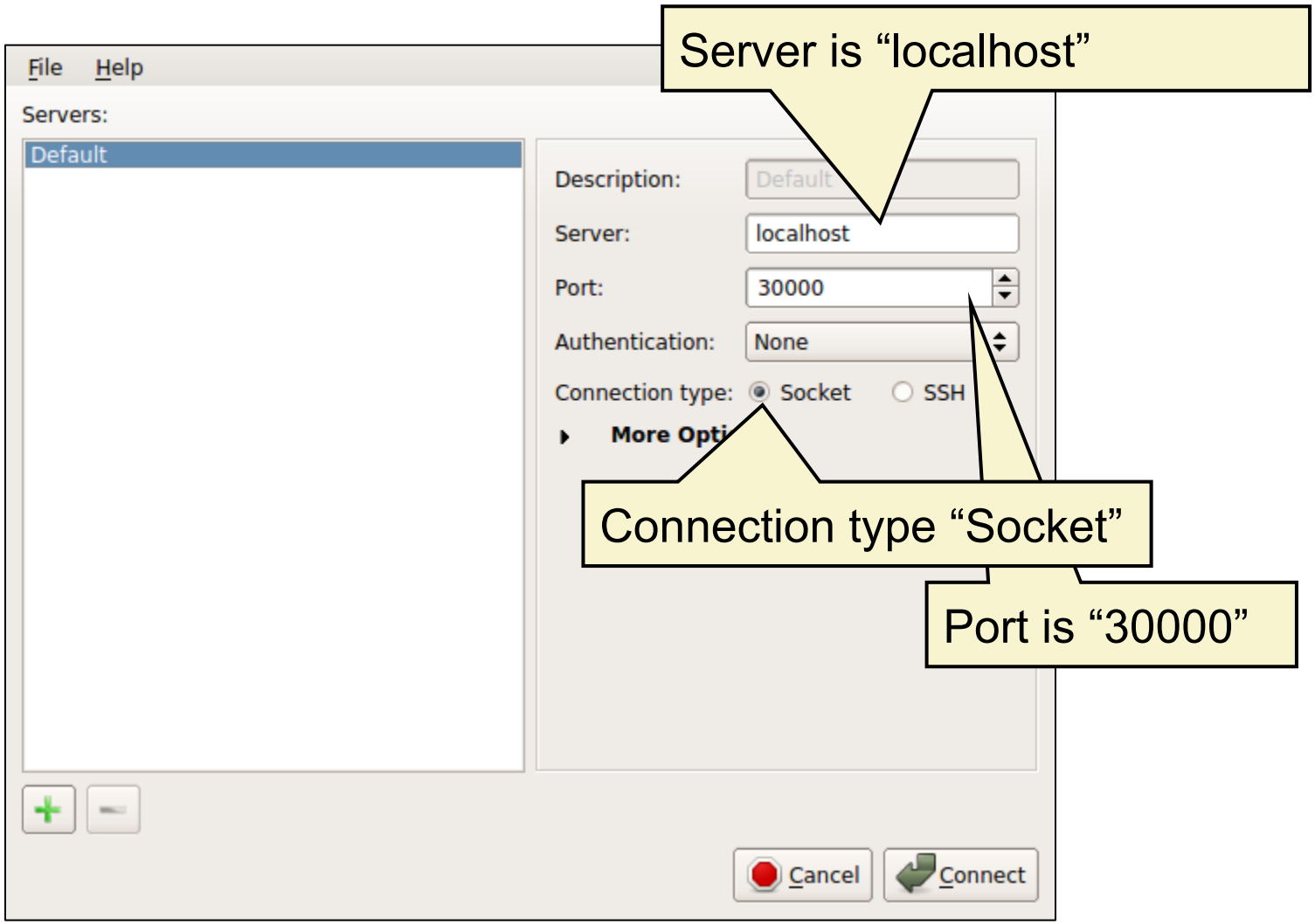
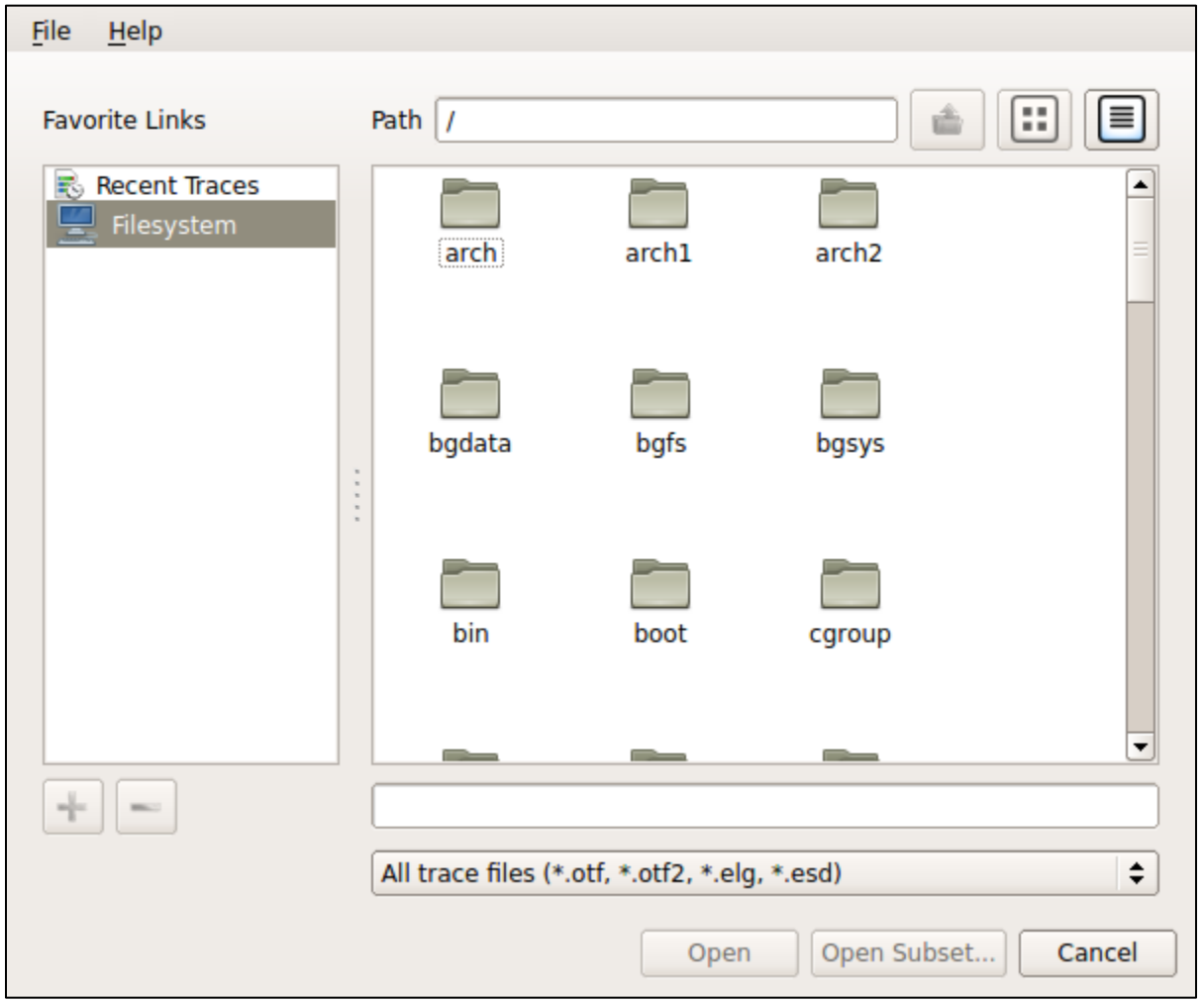


Option B: Step 2, Install Vampir client locally



Summary and Conclusion

Summary

- Vampir & VampirServer
  - Interactive trace visualization and analysis
  - Intuitive browsing and zooming
  - 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 does neither solve your problems automatically, nor point you directly at them. It does, however, give you FULL insight into the execution of your application.

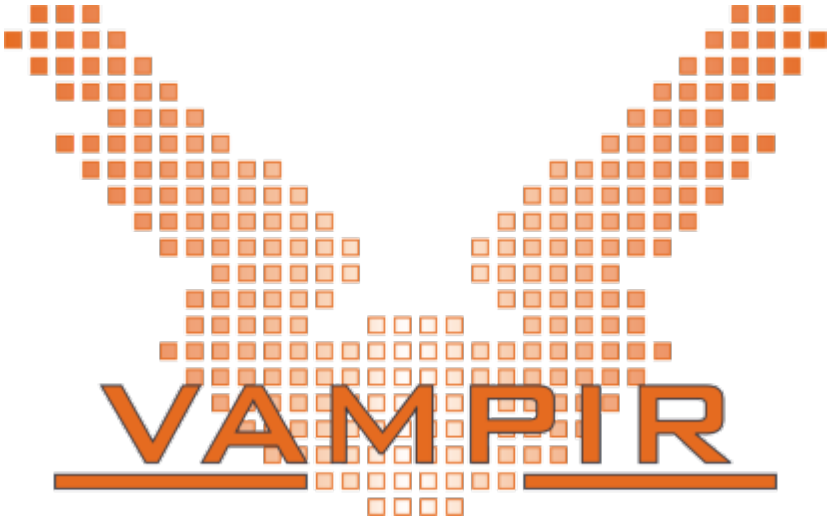
Conclusion

- Performance analysis very important in HPC

- Use performance analysis tools for profiling and tracing
- Do not spend effort in DIY solutions,
  e.g. like printf-debugging

- Use tracing tools with some precautions
  - Overhead
  - Data volume

- Let us know about problems and about feature wishes
- vampirsupport@zih.tu-dresden.de



Vampir is available at http://www.vampir.eu,

get support via vampirsupport@zih.tu-dresden.de