Performance Analysis with Vampir

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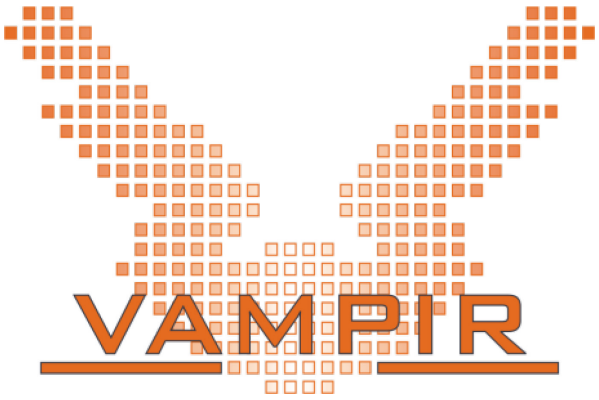
Part I: Welcome to the Vampir Tool Suite

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

Part II: Vampir Hands On

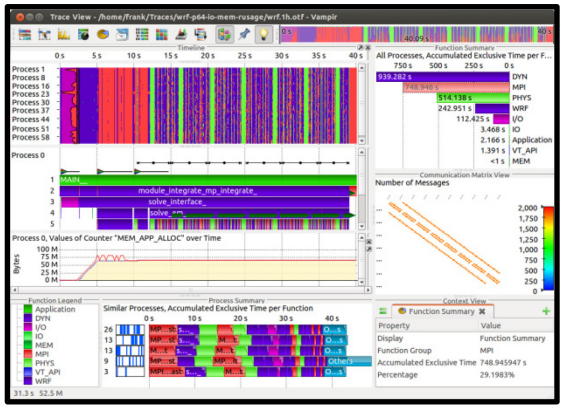
- Visualizing and analyzing NPB-MZ-MPI / BT

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:

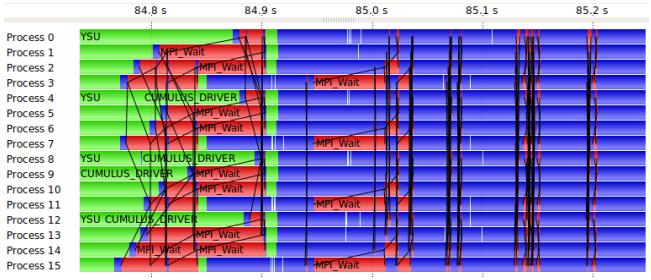
- What happens in my application execution during a given time in a given process or thread?
- How do the communication patterns of my application execute on a real system?
- Are there any imbalances in computation, I/O or memory usage and how do they affect the parallel execution of my application?

Event Trace Visualization with Vampir

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

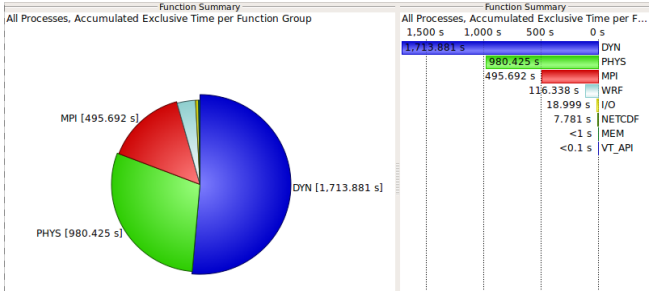
Timeline charts

– Show application activities and communication along a time axis



Summary charts

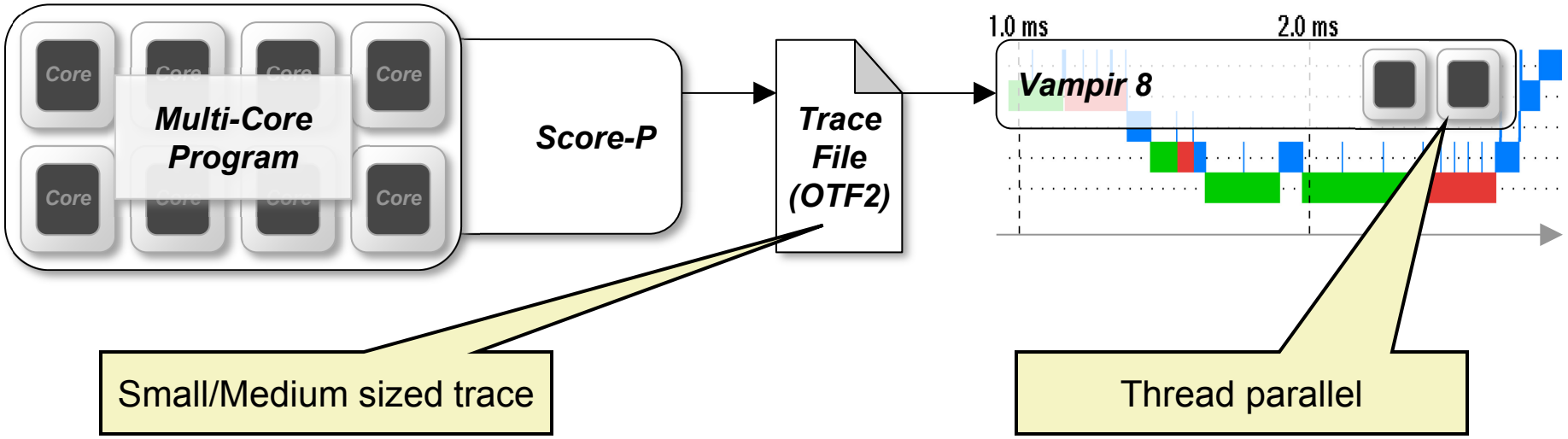
– Provide quantitative results for the currently selected time interval



Vampir – Visualization Modes (1)

- Directly on front end or local machine

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

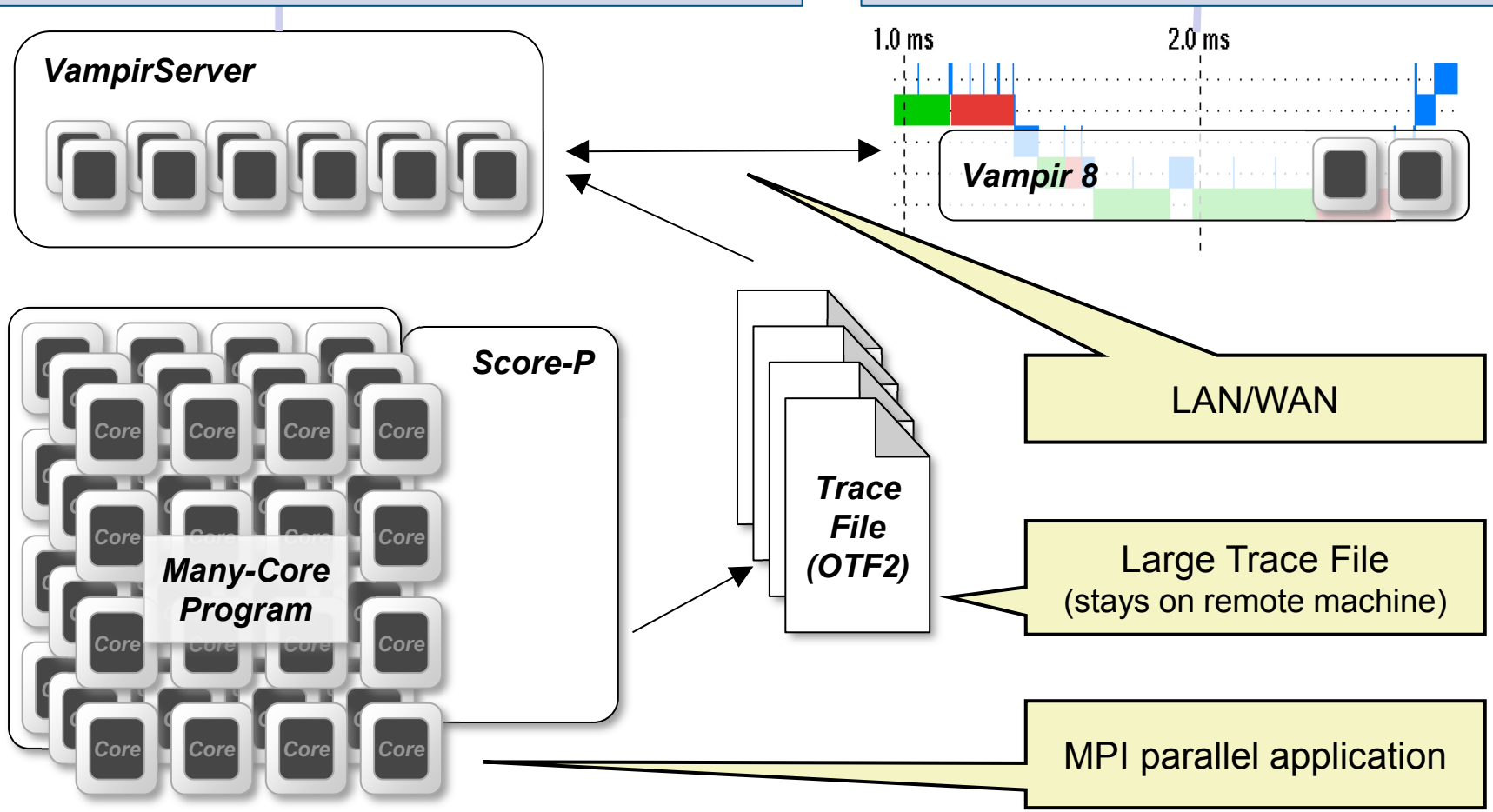


Vampir – Visualization Modes (2)

- On local machine with remote VampirServer

```
% module load UNITE vampirserver
% vampirserver start -n 12
```

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



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

Option A: Starting Vampir on MareNostrum III

- Load modules

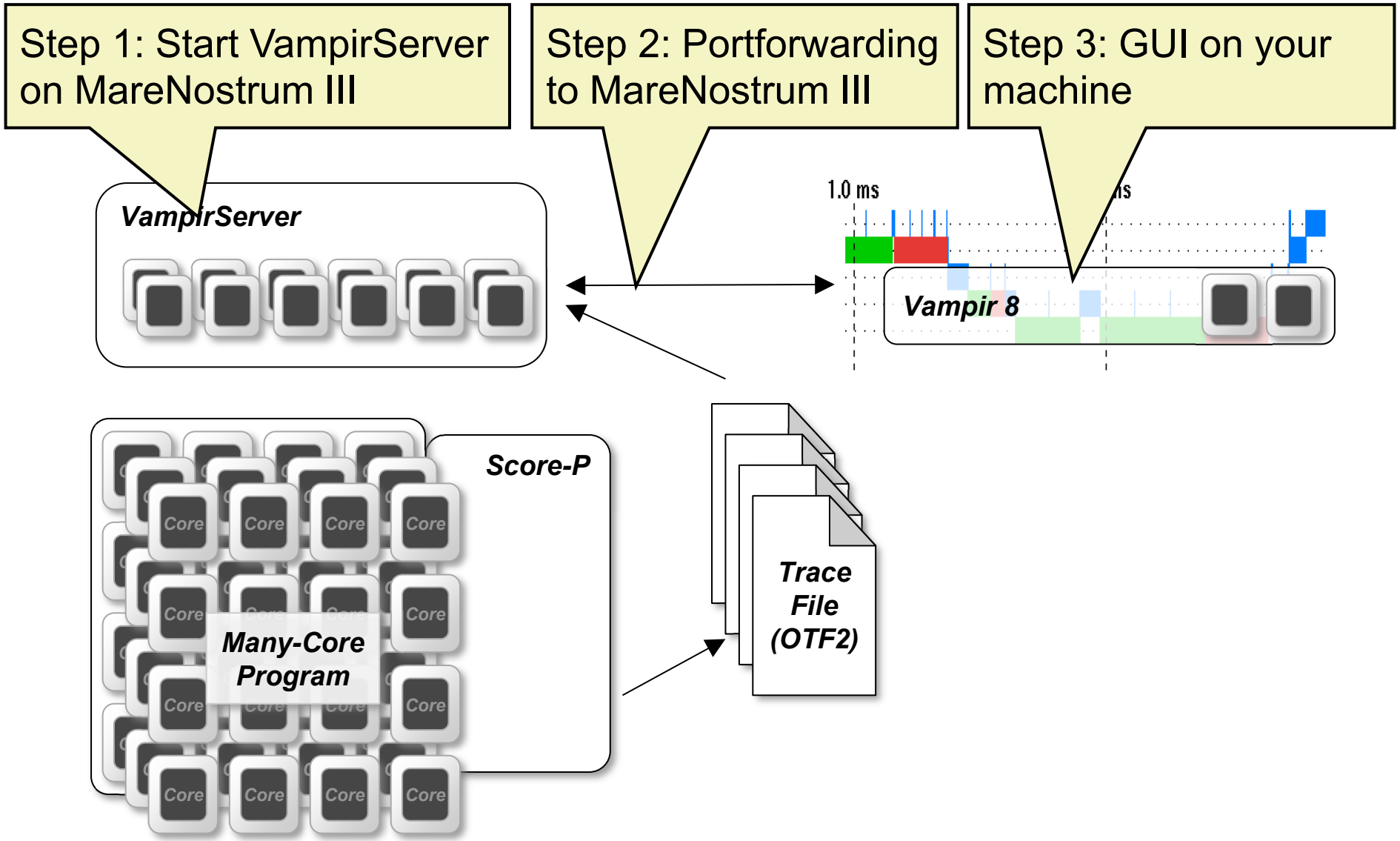
```
% module load UNITE
UNITE loaded

% module load vampir
Vampirserver 8.2 loaded
```

- Start a vampir as an X11 job

```
% bsub -W 30 -q x11 vampir
Job <753820> is submitted to queue <x11>.
```

- The GUI comes up once the job is submitted (use “bjobs” to query for your job status)
- Use the following to connect to MareNostrum III:
  $ **ssh –XC …**
- This enables X11 forwarding AND compression, the latter is crucial for a good usage experience

Option B: Overview



Option B: Step 1, Start a Vampirserver on MareNostrum III

- Load modules

```
% module load UNITE
UNITE loaded

% module load vampirserver
Vampirserver 8.2 loaded
```

- Start a vampirserver job on the compute nodes

```
% vampirserver start -n 3
Launching VampirServer...
Submitting LSF batch job (this might take a while)...
VampirServer 8.2.0  (r8690)
Licensed to VI-HPS Tools Workshop 02/2014
Running 3 analysis processes... (abort with vampirserver stop 8921)
VampirServer <8921> listens on: s04r1b78:30075
```

Remember these coordinates we will need them in a second

Option B: Step 2, Port Forwarding to MareNostrum III

- Write down the host on which the server runs

```
% vampirserver start -n 3
Launching VampirServer...
Submitting LSF batch job (this might take a while)...
VampirServer 8.2.0  (r8690)
Licensed to VI-HPS Tools Workshop 02/2014
Running 3 analysis processes... (abort with vampirserver stop 8921)
VampirServer <8921> listens on: s04r1b78:30075
```

- Establish Port Forwarding from your local machine to MareNostrum III

```
% ssh \
    -L 30000:s04r1b78:30075 \
    <user>@mn1.bsc.es
```

Option B: Step 2, Install the Vampir Client on your Laptop

- Start a new shell on you laptop
- Copy the vampir-remote.zip package from MareNostrum III to your laptop

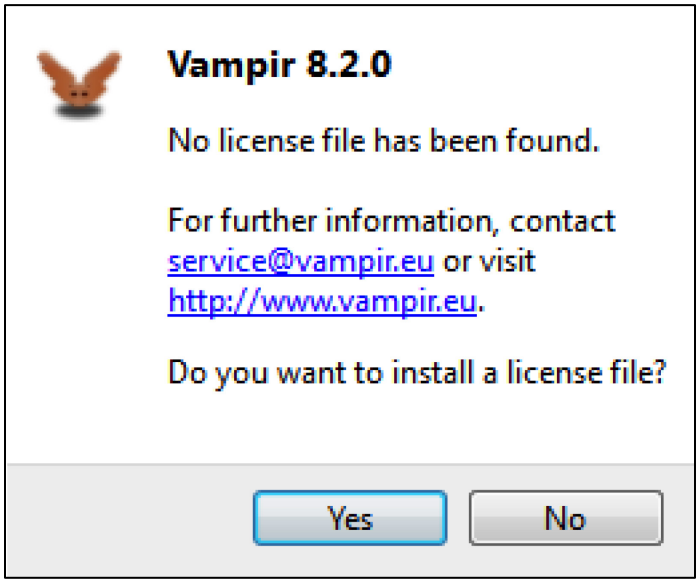
```
% scp mn1.bsc.es:/gpfs/projects/nct00/nct00001/UNITE/tutorial/vampir-remote.zip
```

- Extract the archive and chose an appropriate package for your platform

```
% unzip vampir-remote.zip
% cd vampir-remote
% ls
vampir-8.2.0-remote-linux-ia32-setup.bin
vampir-8.2.0-remote-linux-x86_64-setup.bin
Vampir-8.2.0-remote-mac.dmg
Vampir-8.2.0-Remote-x64-setup.exe
Vampir-8.2.0-Remote-x86-setup.exe
vampir-remote.license
```

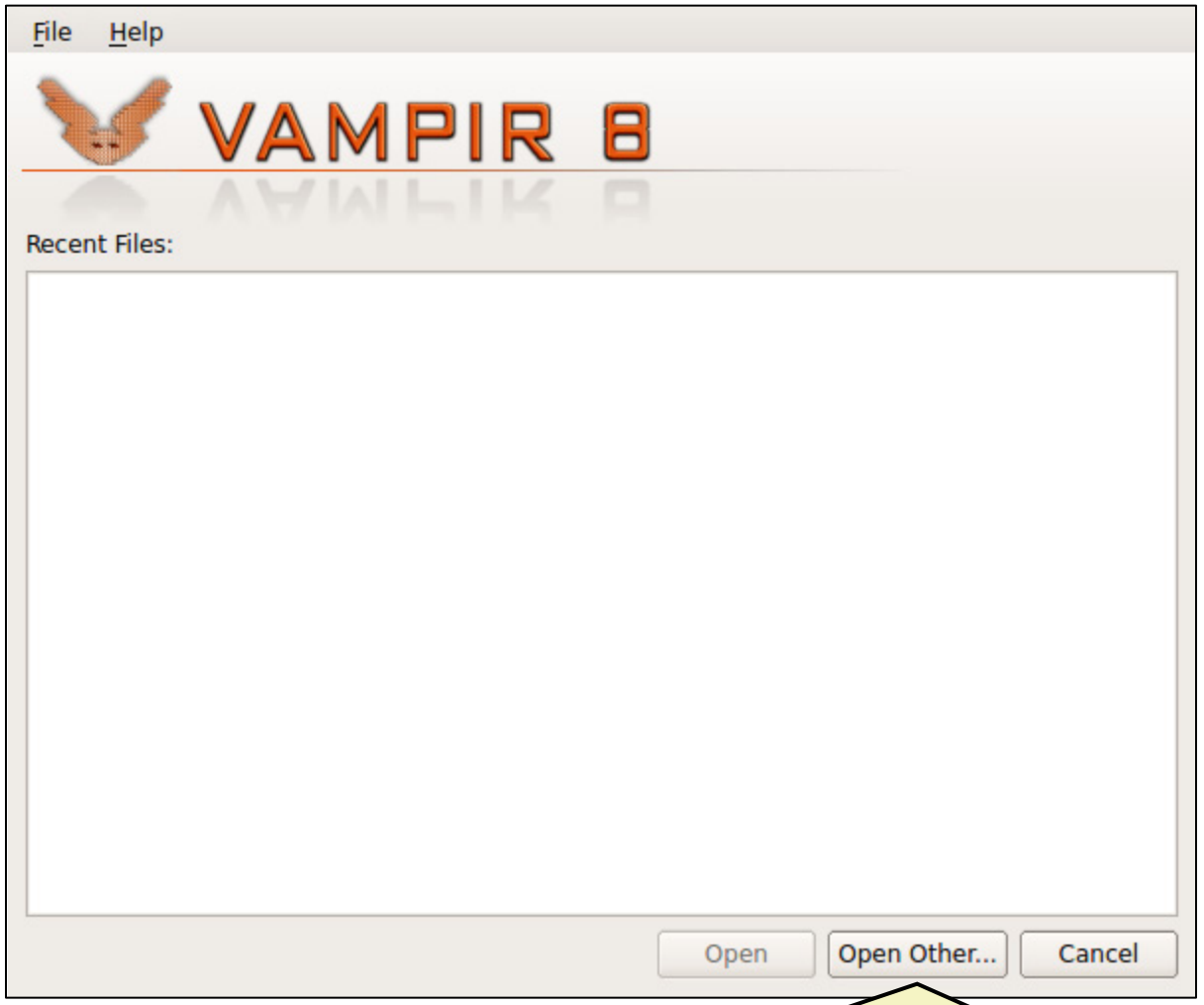
- Install and start the Vampir GUI

Option B: Step 2, Install the Vampir Client on your Laptop – License



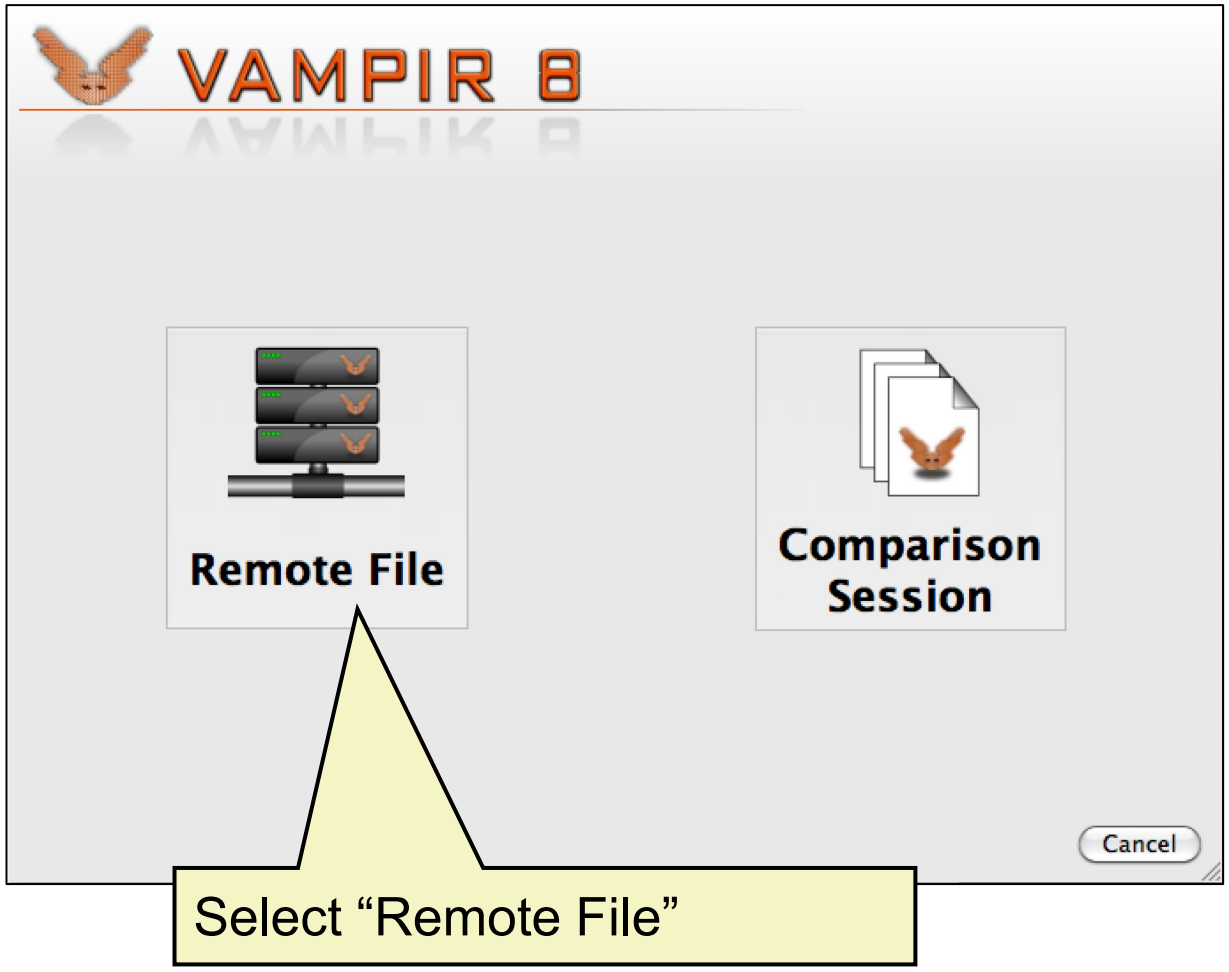
- Select the vampir-remote.licence from the archive file when asked

Option B: Step 2, Install the Vampir Client on your Laptop – Open (1)

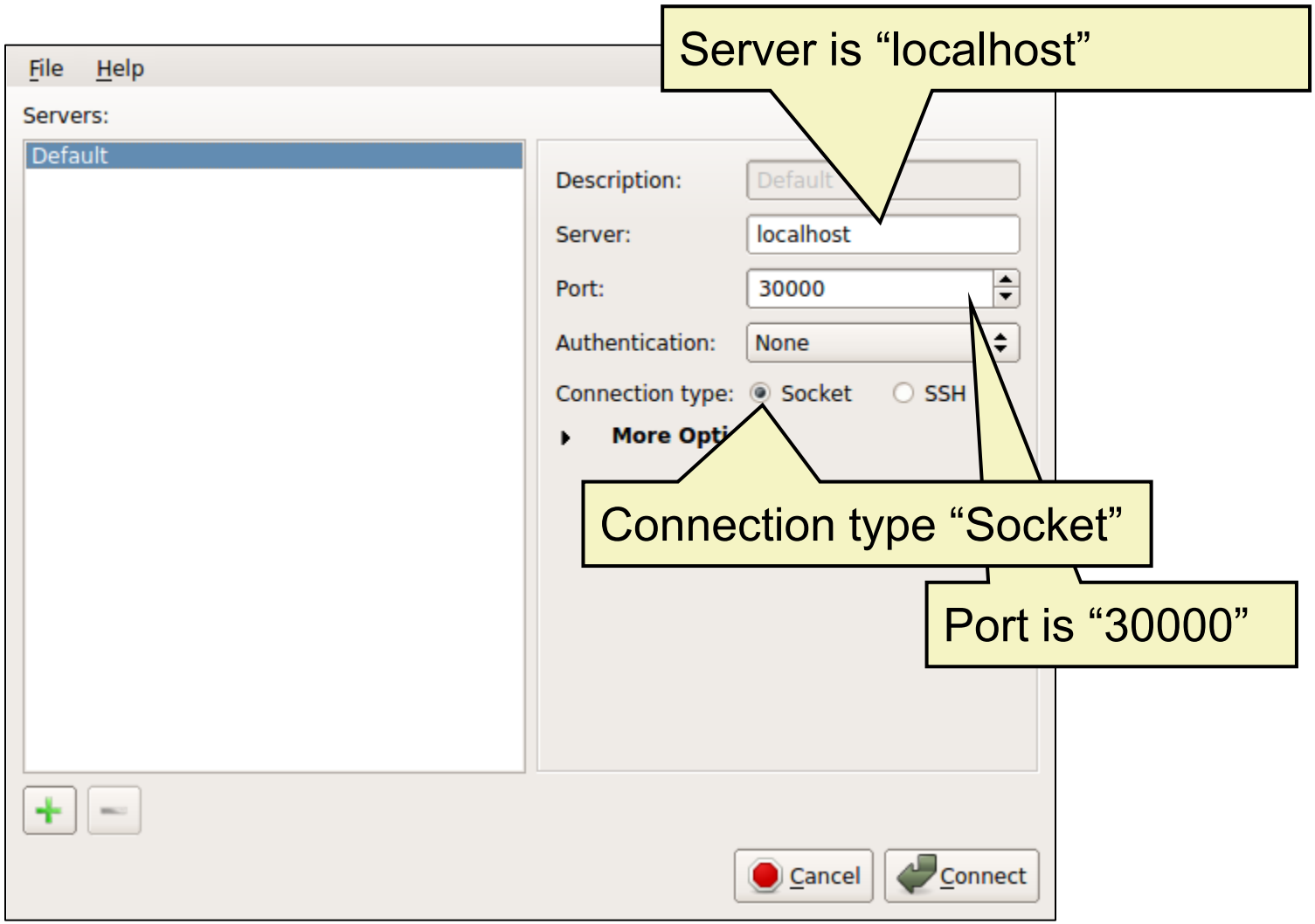


Use the “Open Other” option

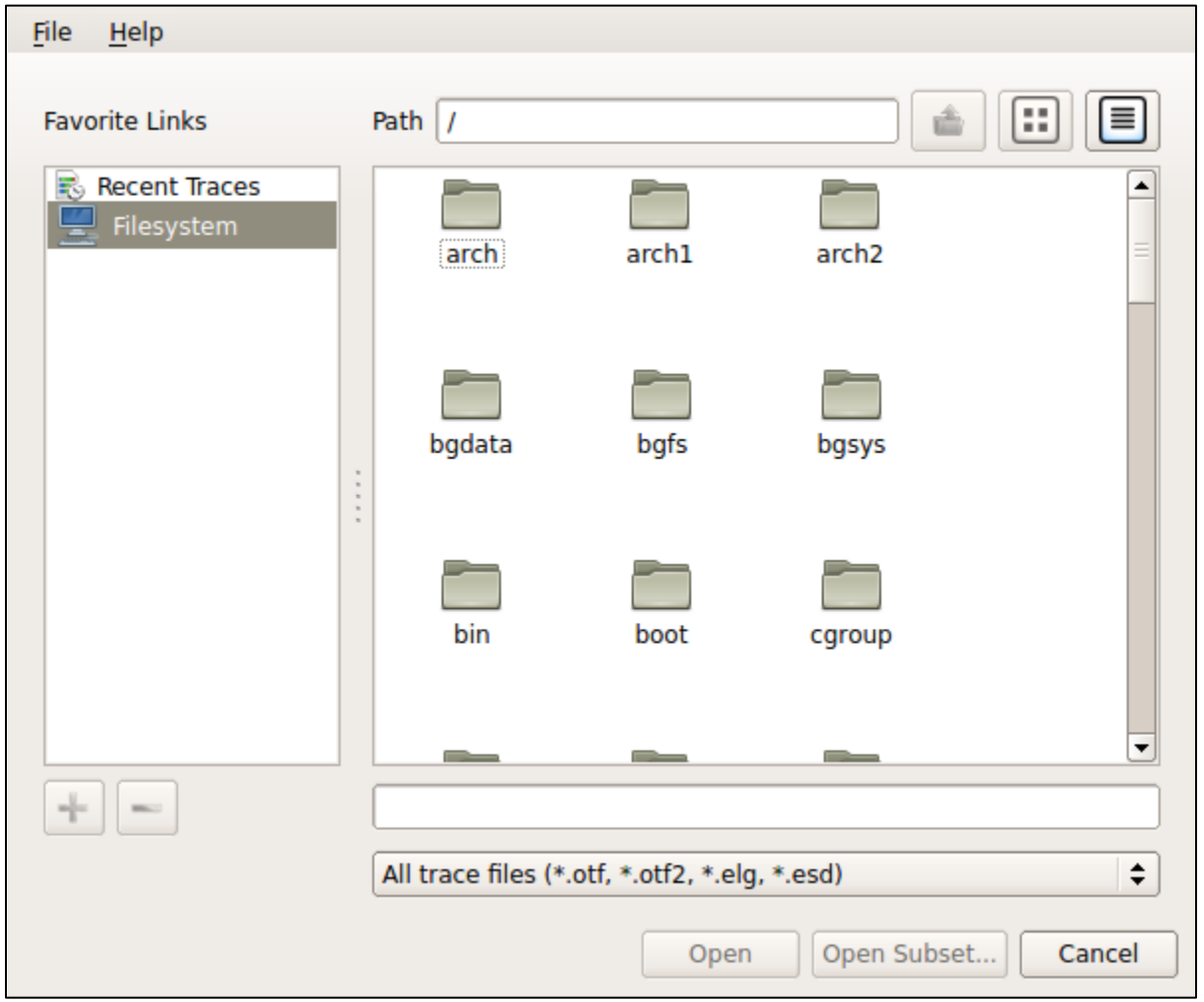
Option B: Step 2, Install the Vampir Client on your Laptop – Open (2)



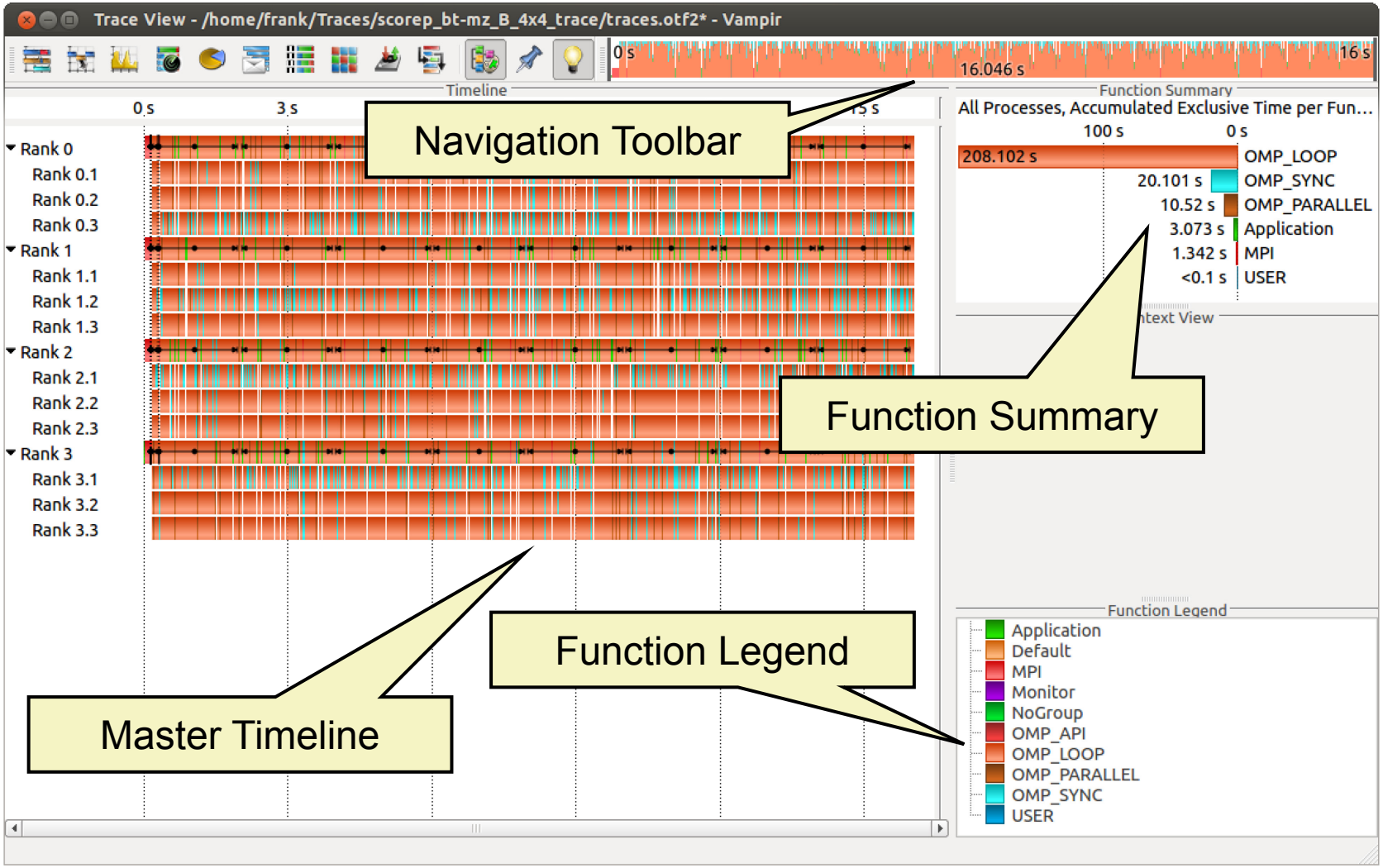
Option B: Step 2, Install the Vampir Client on your Laptop – Open (3)



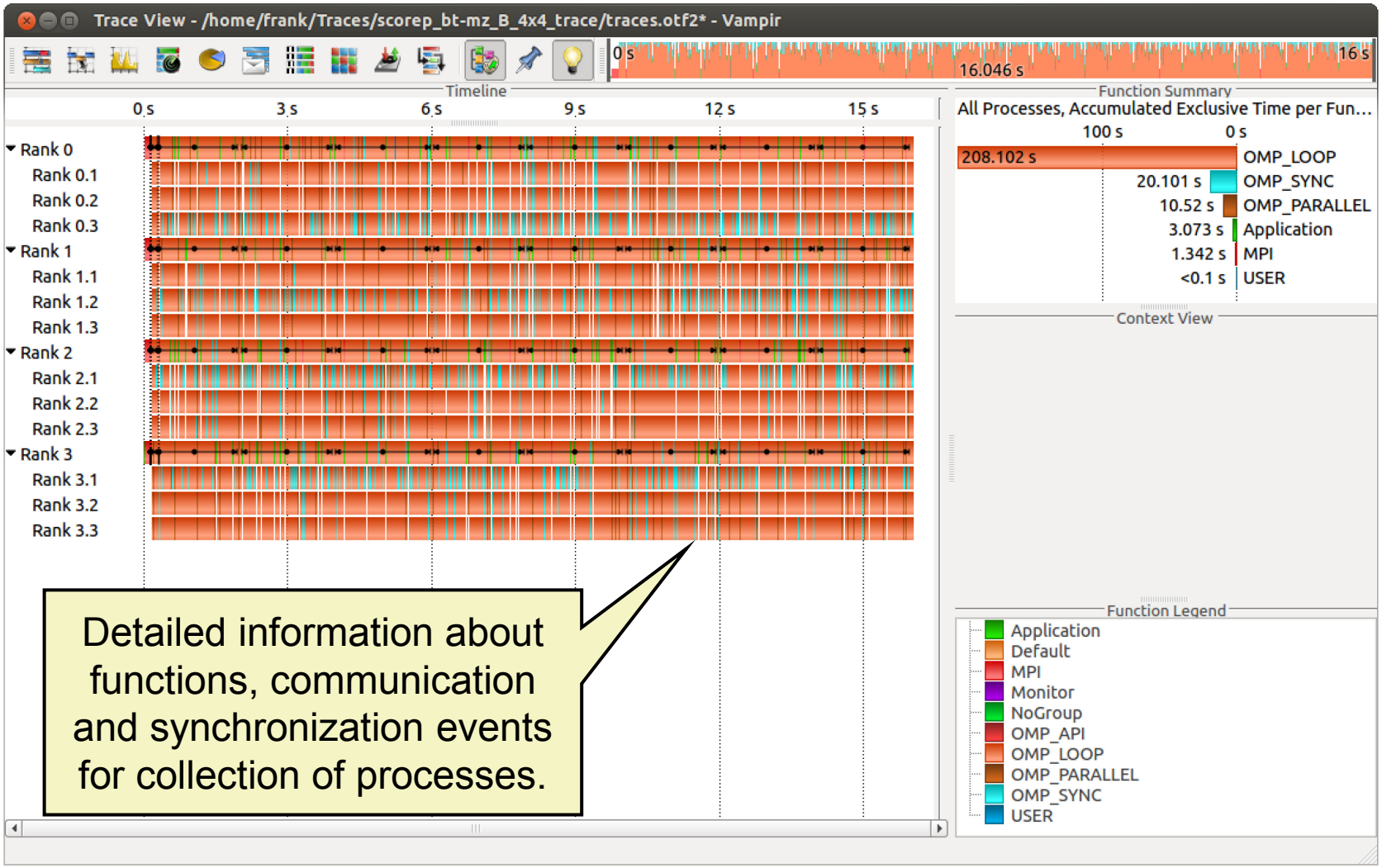
Option B: Step 2, Install the Vampir Client on your Laptop – Open (4)



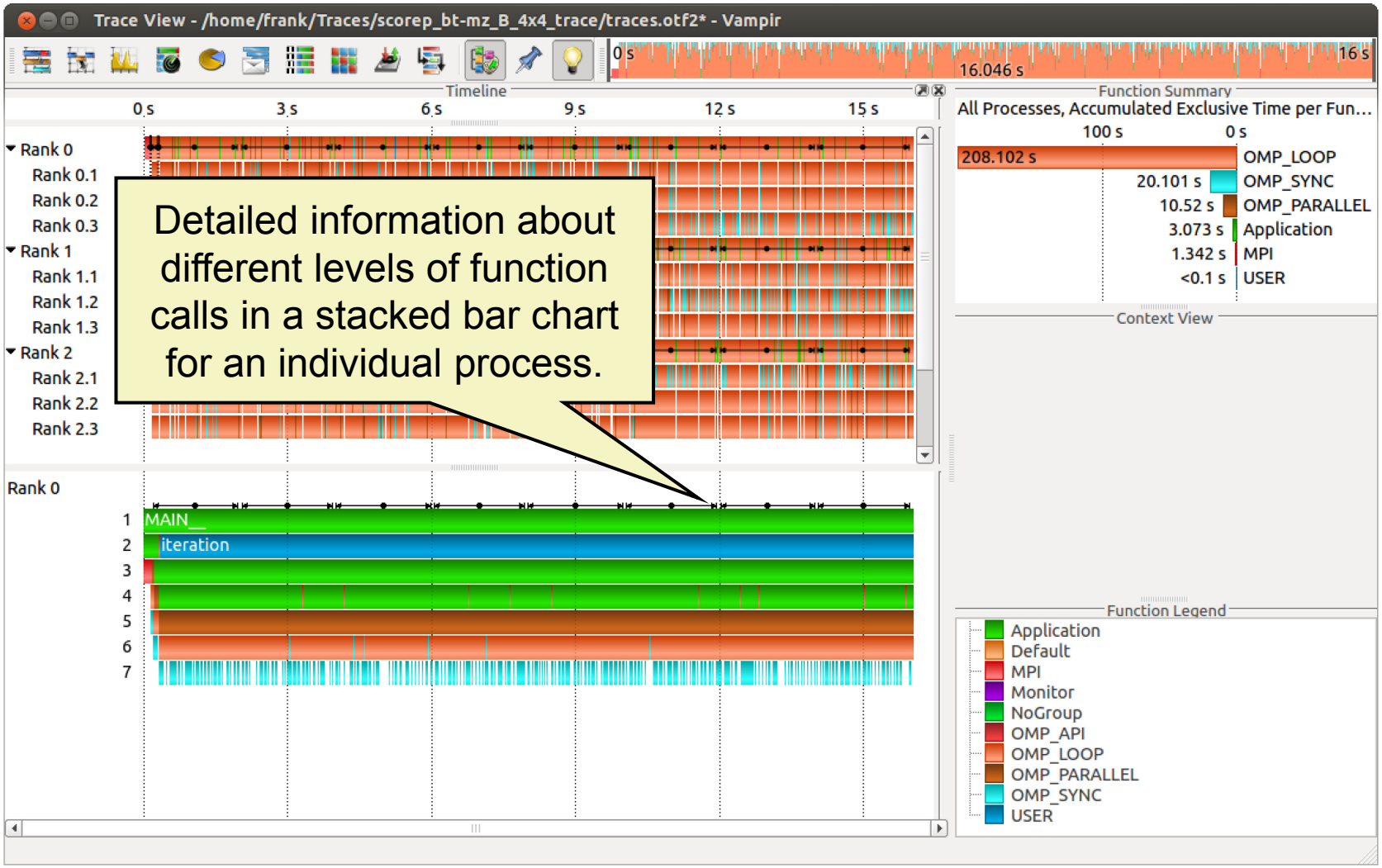
Vampir: Visualization of the NPB-MZ-MPI / BT trace



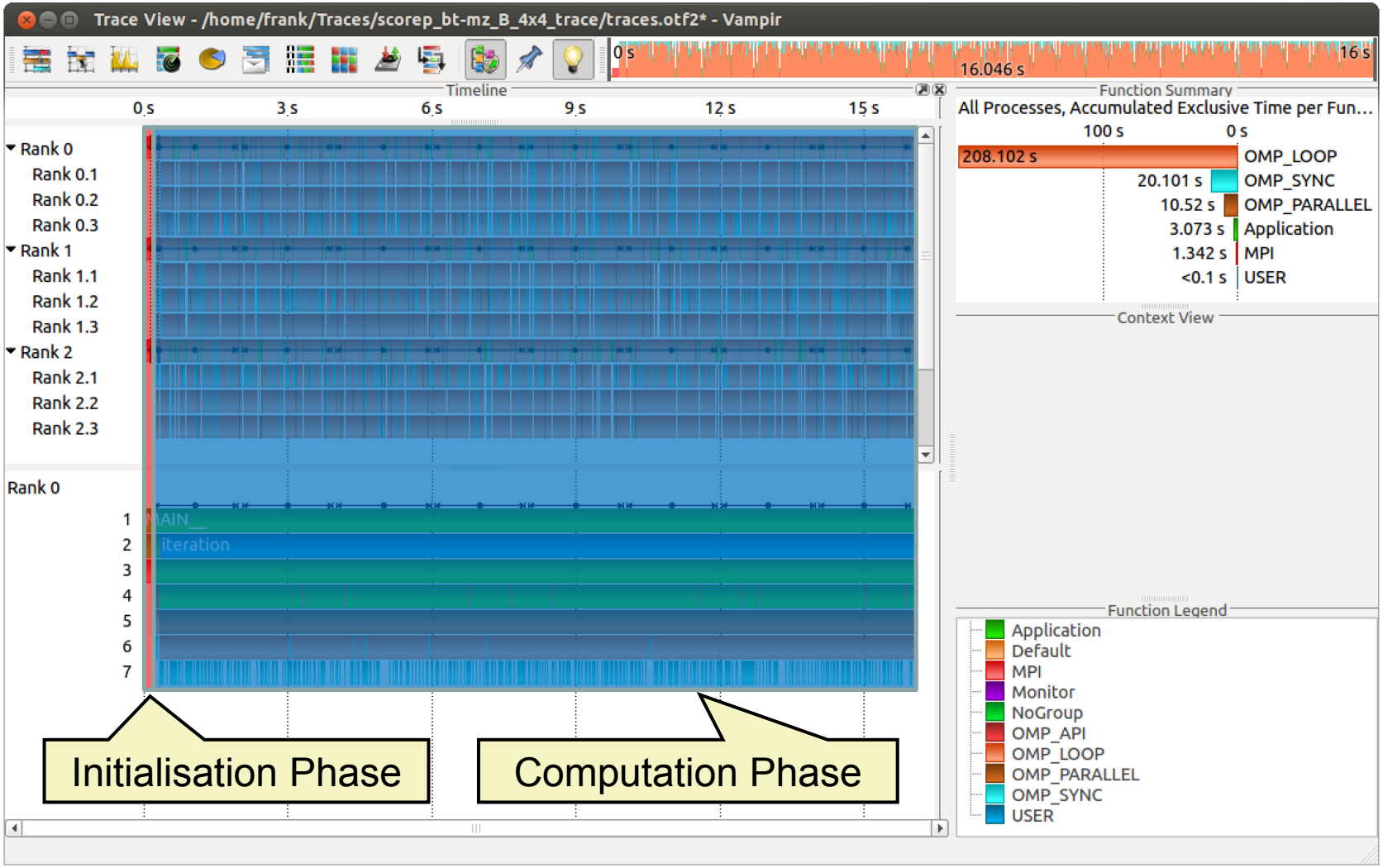
Master Timeline



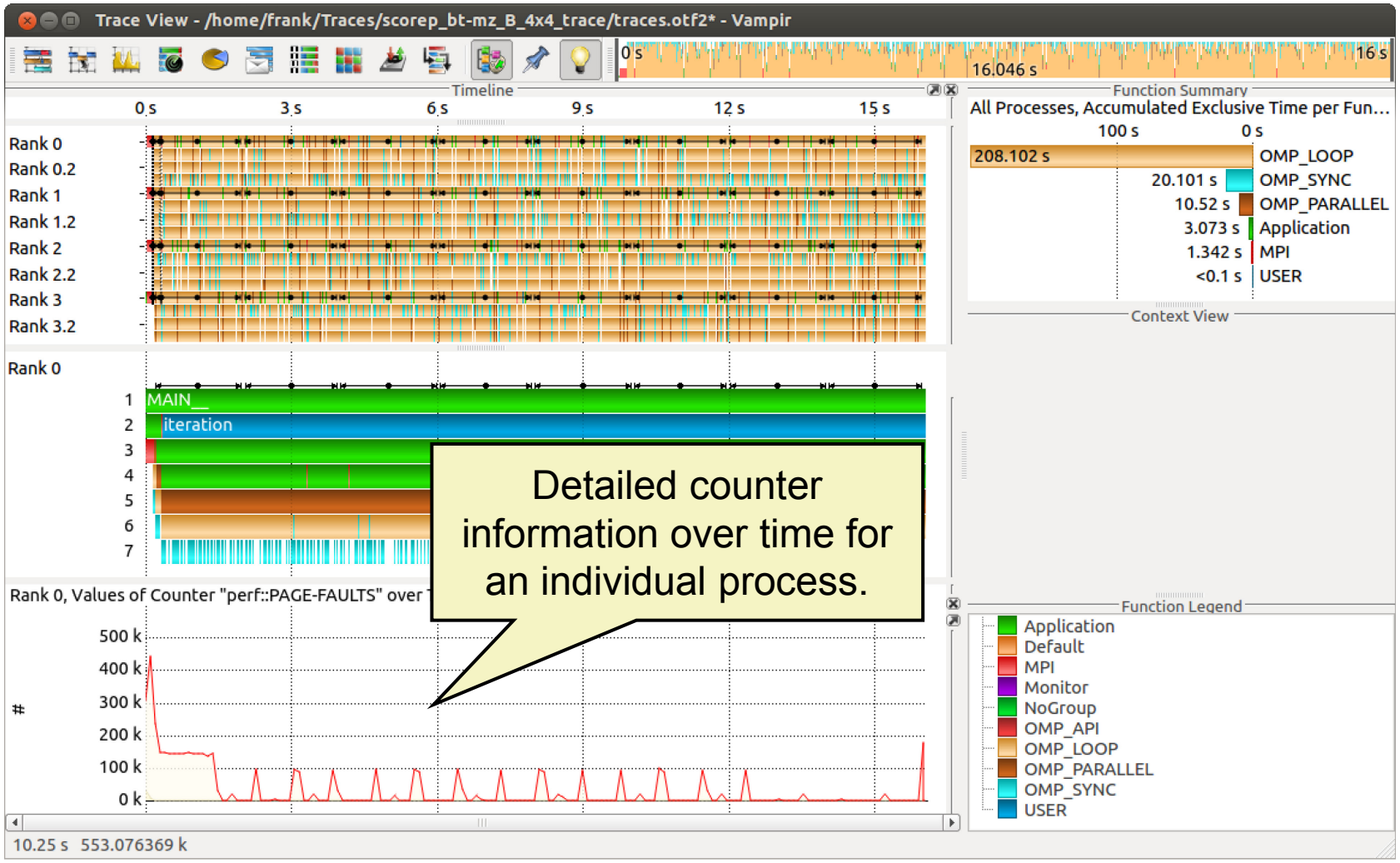
Process Timeline



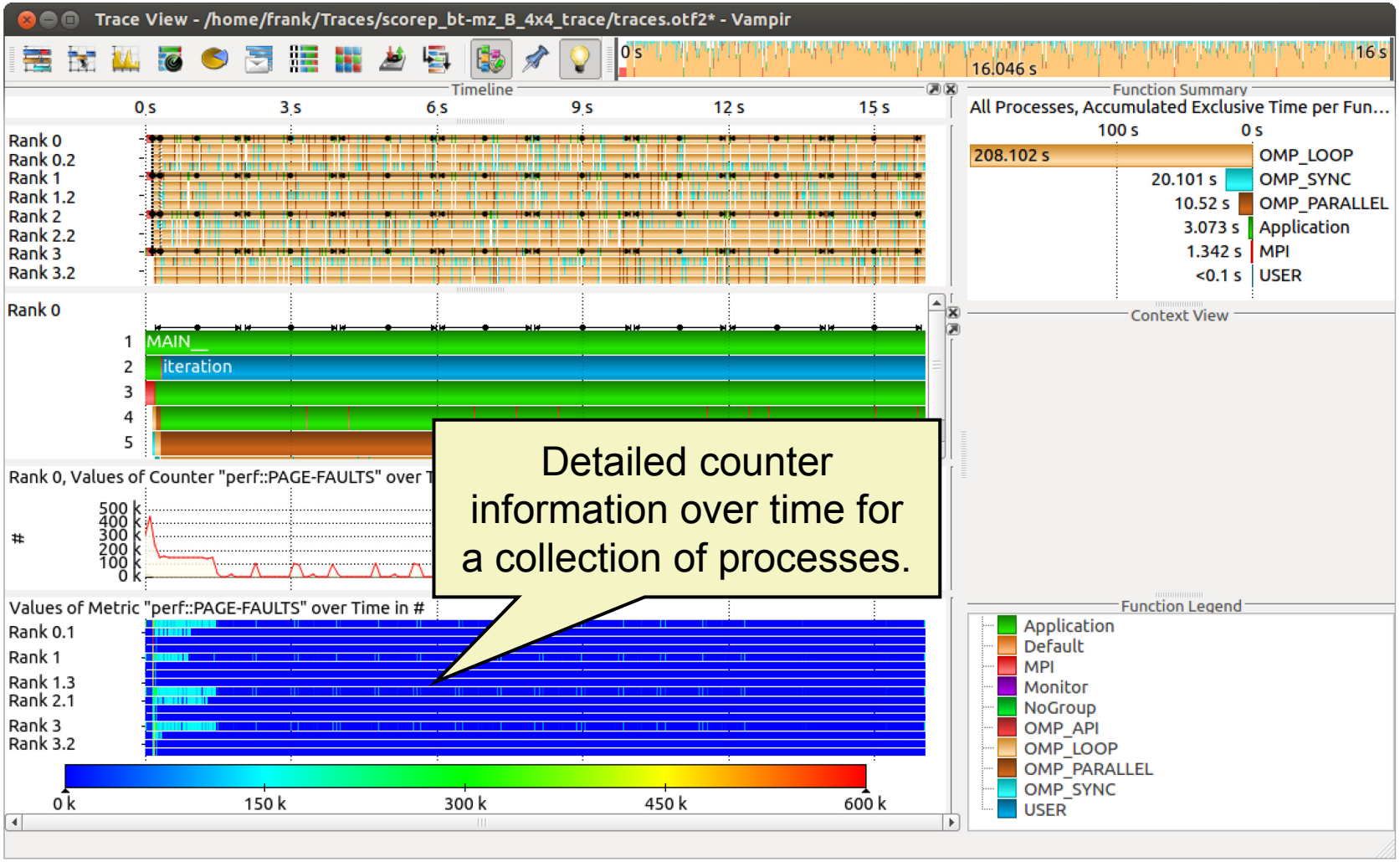
Typical program phases



Counter Data Timeline

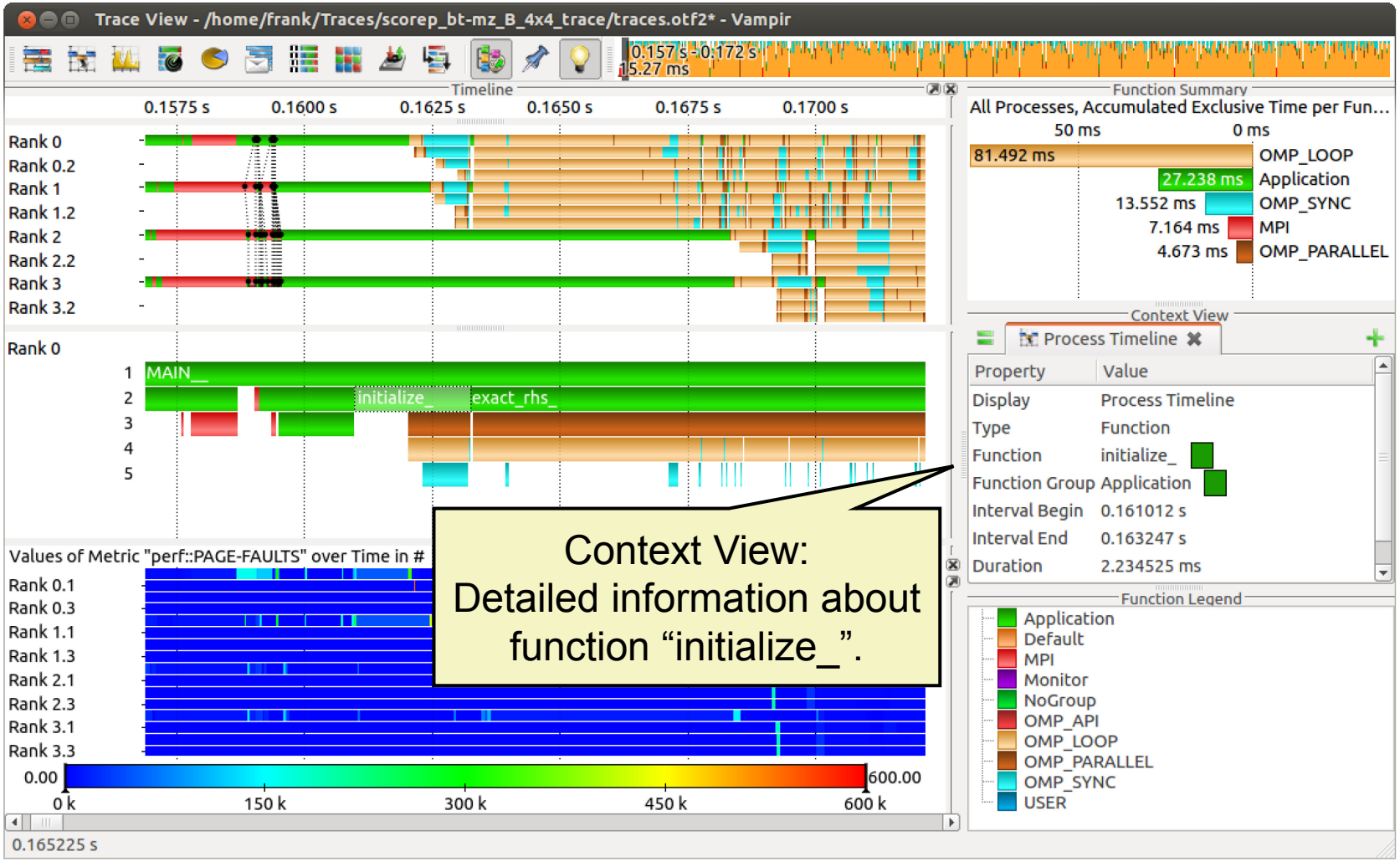


Performance Radar

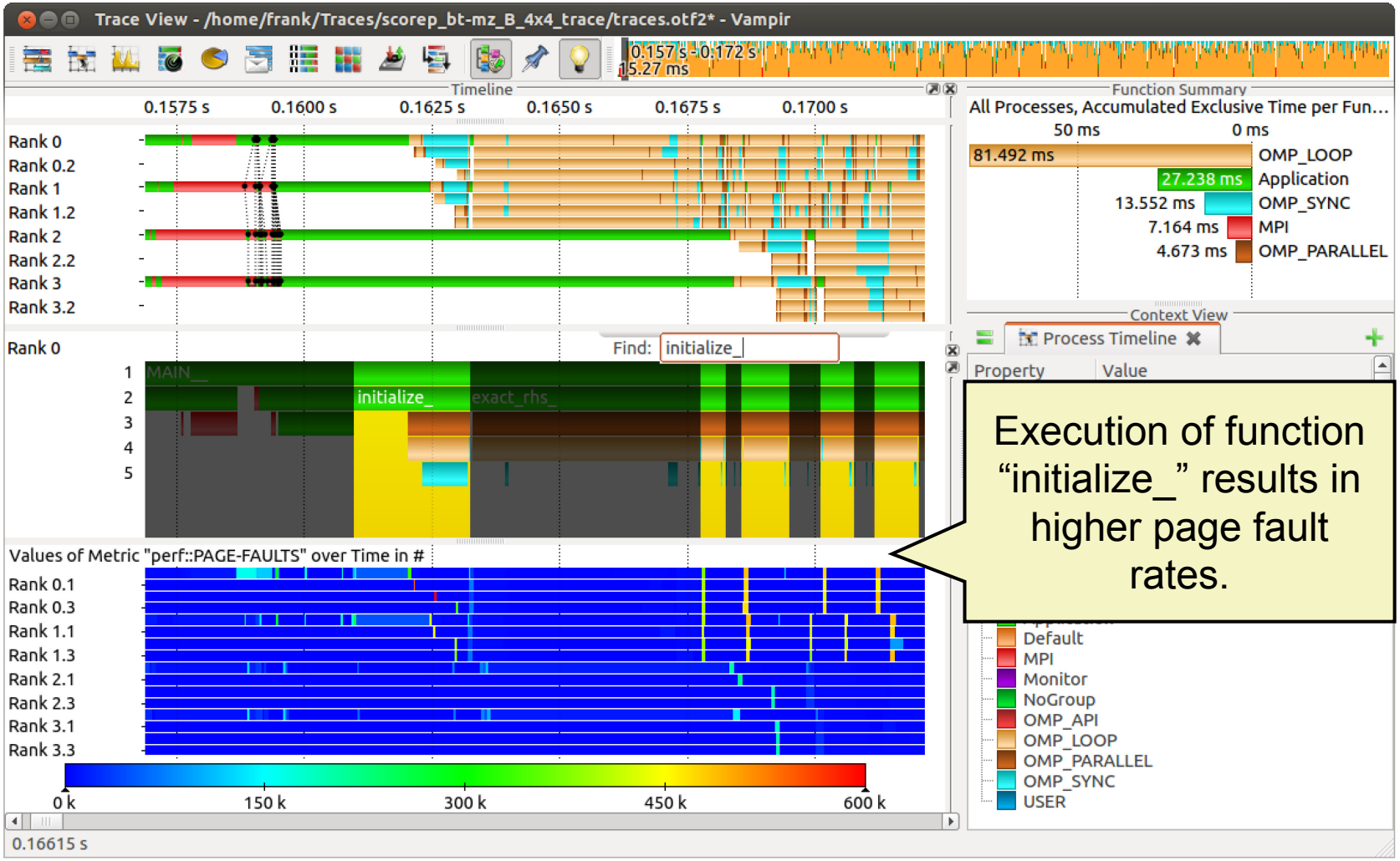


Vampir: Visualization of the NPB-MZ-MPI / BT trace

Zoom in: Inititialisation Phase

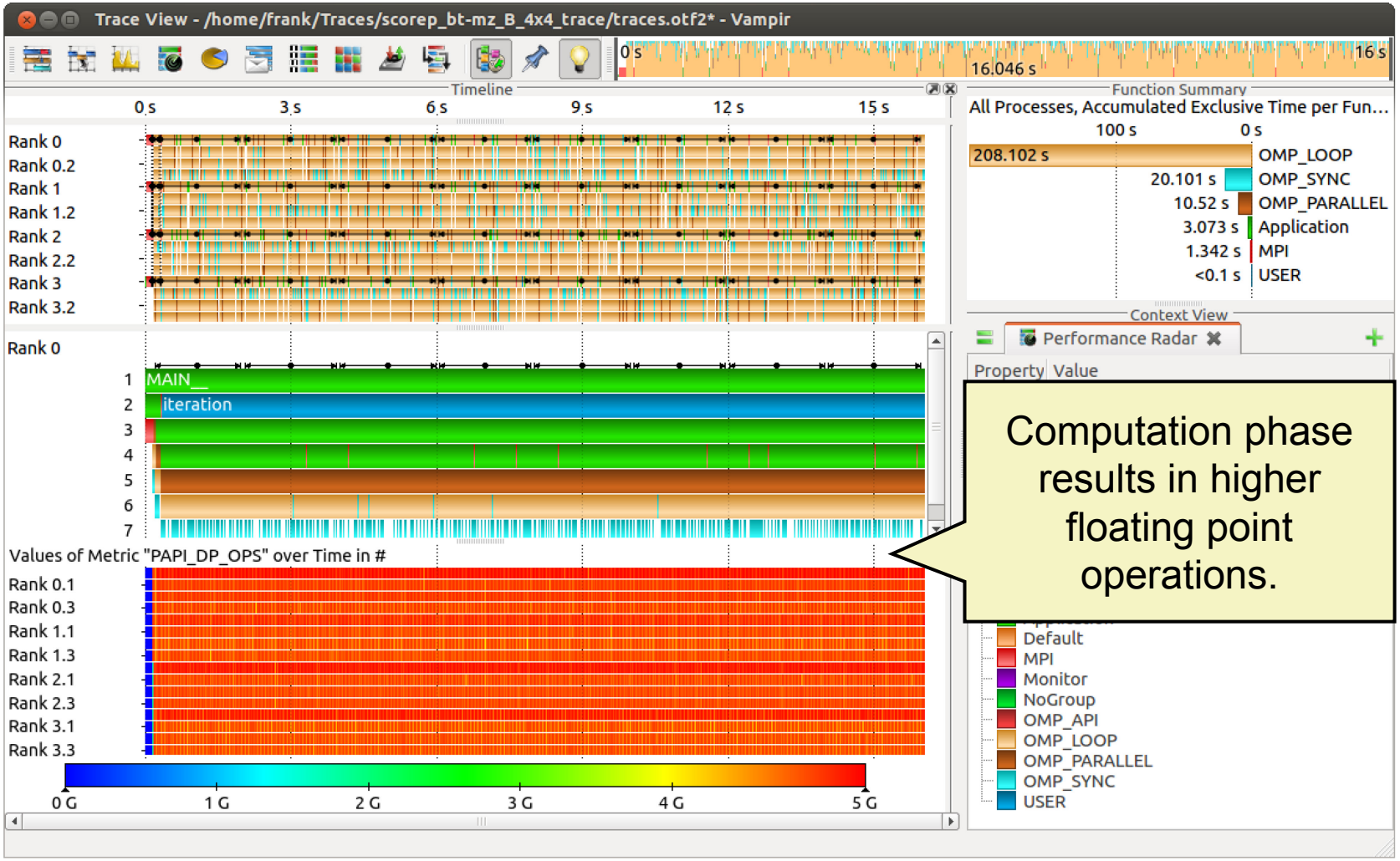


Feature: Find Function



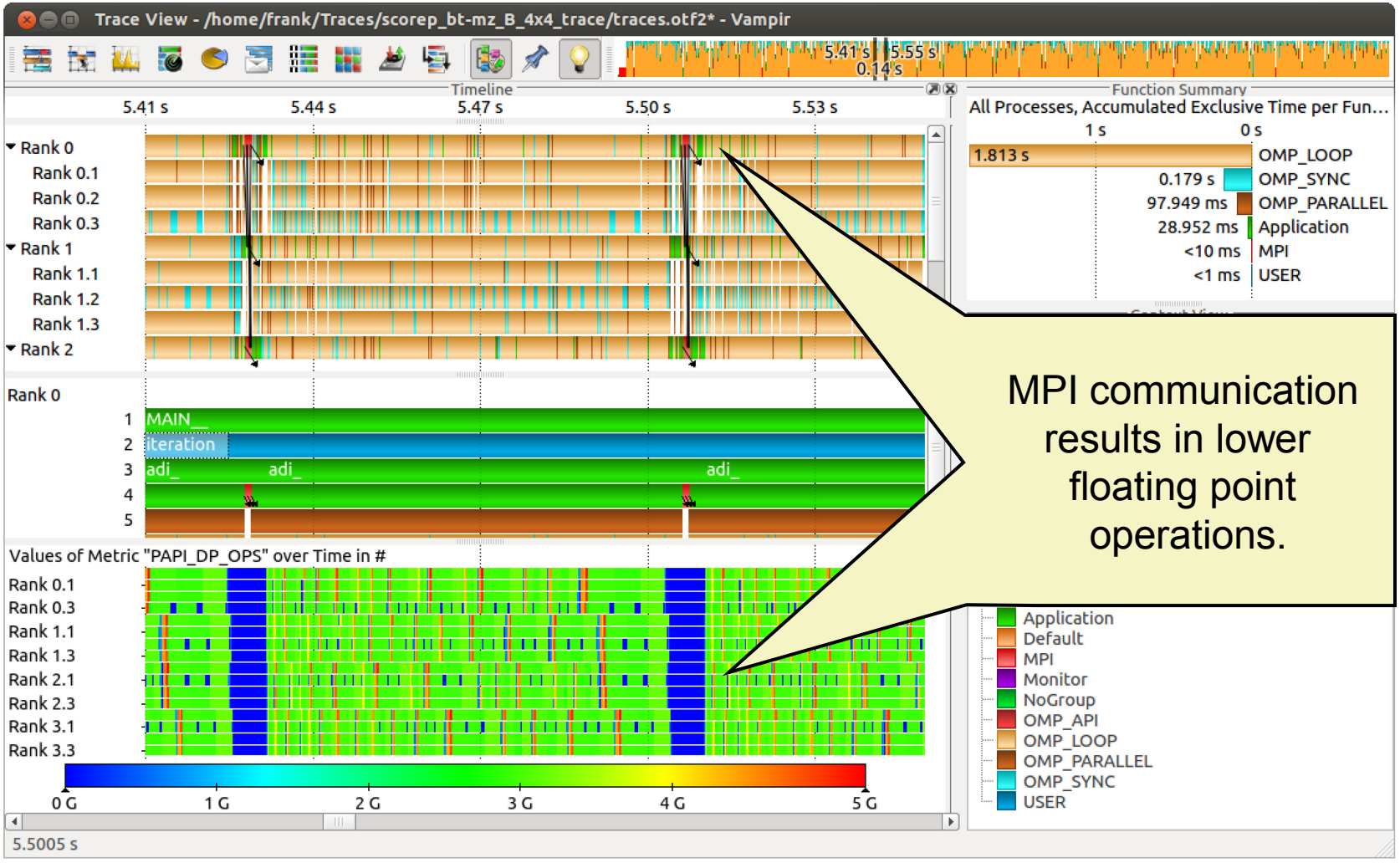
Vampir: Visualization of the NPB-MZ-MPI / BT trace

Computation Phase

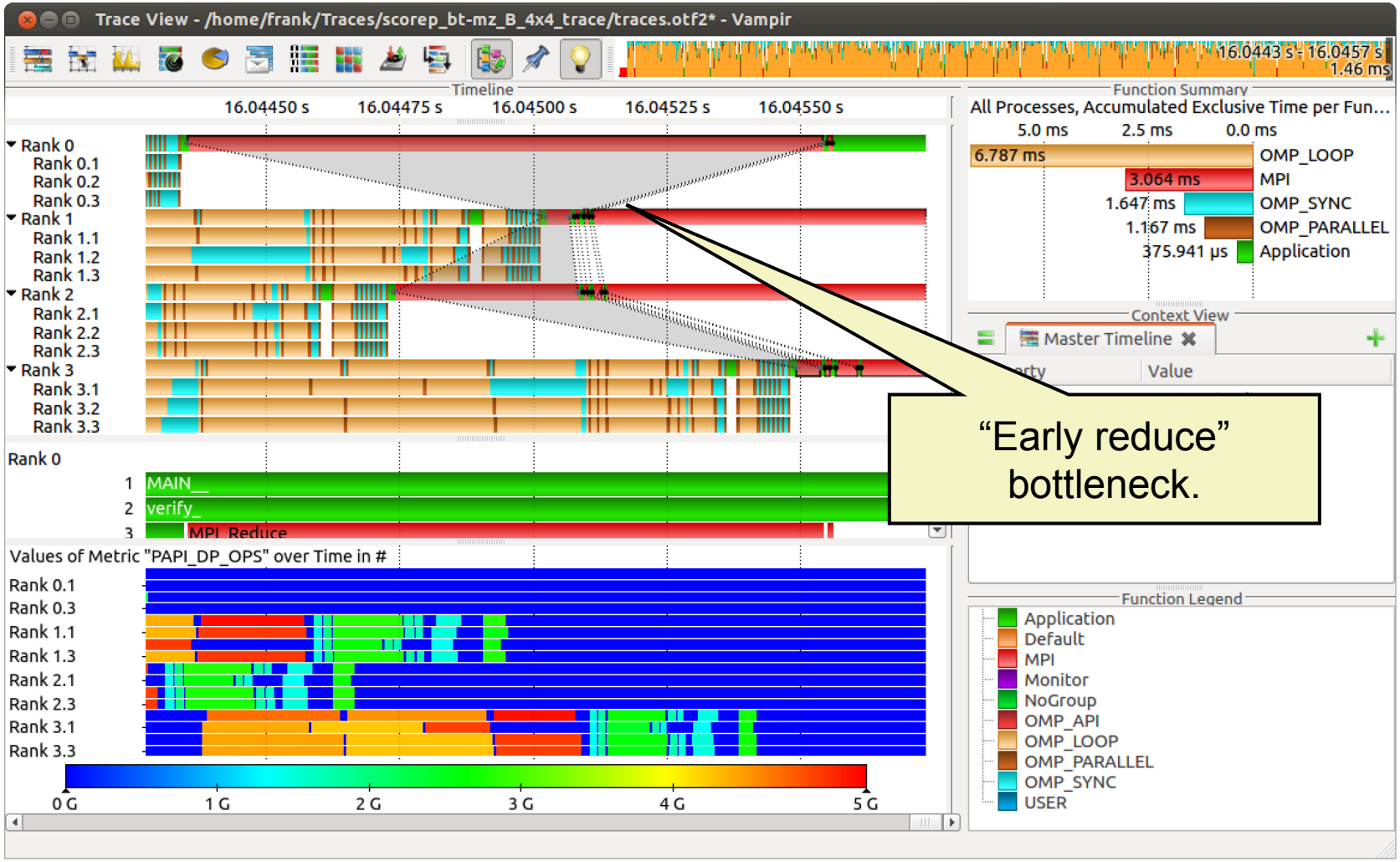


Vampir: Visualization of the NPB-MZ-MPI / BT trace

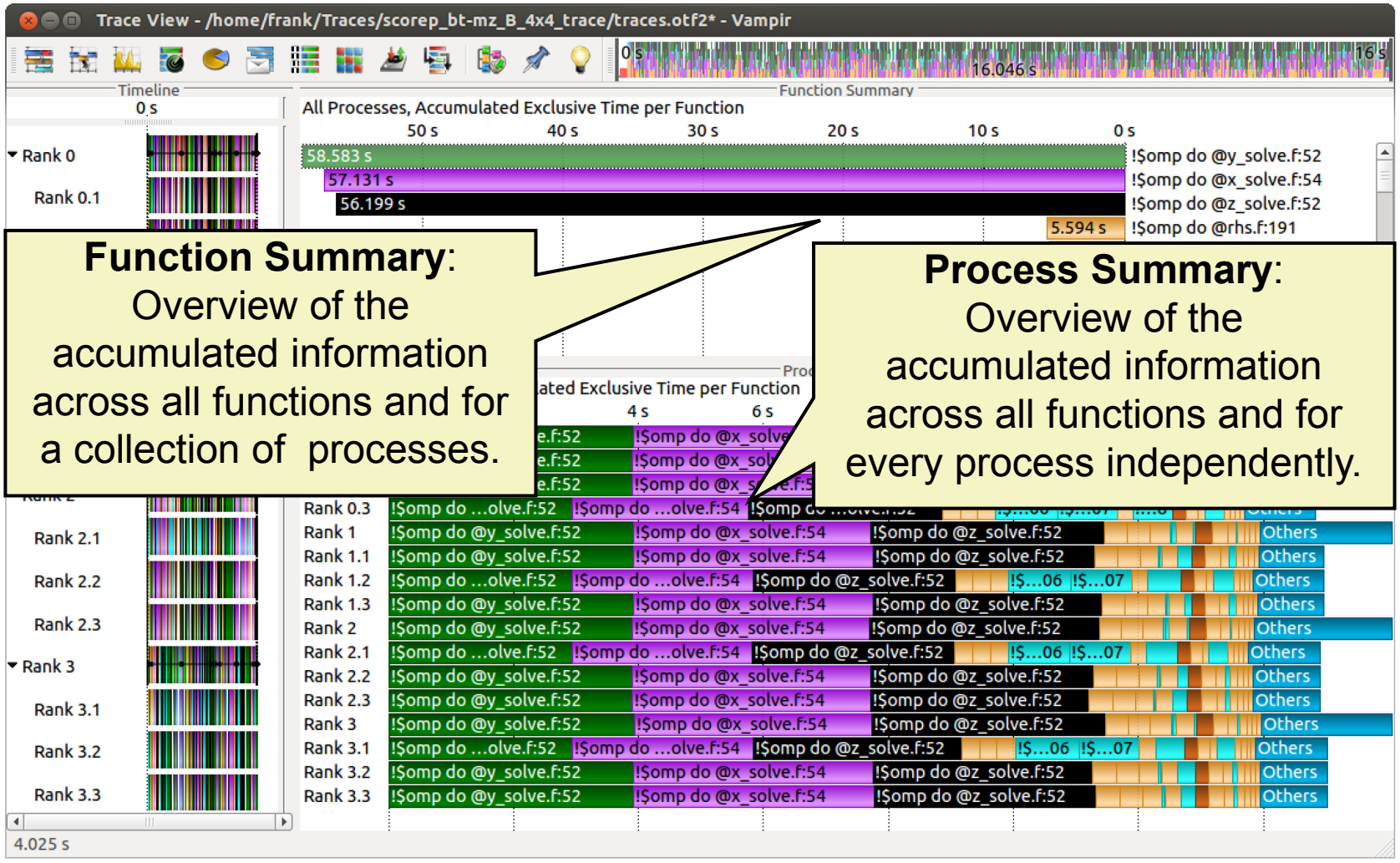
Zoom in: Computation Phase



Zoom in: Finalisation Phase



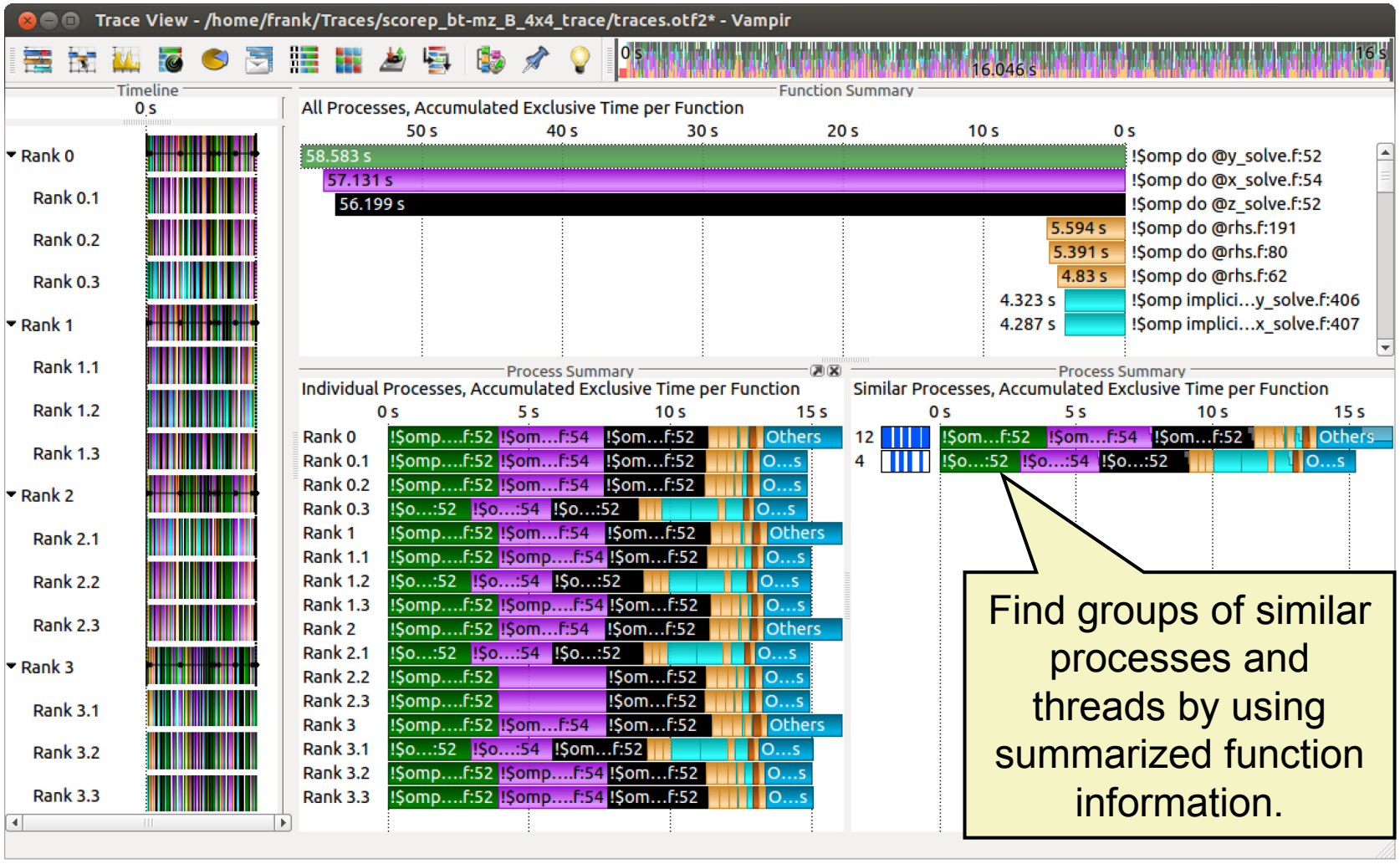
Process Summary



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



Summary and Conclusion

Summary

- Vampir & VampirServer
  - Interactive trace visualization and analysis
  - Intuitive browsing and zooming
  - Scalable to large trace data sizes (20 TByte)
  - Scalable to high parallelism (200000 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.

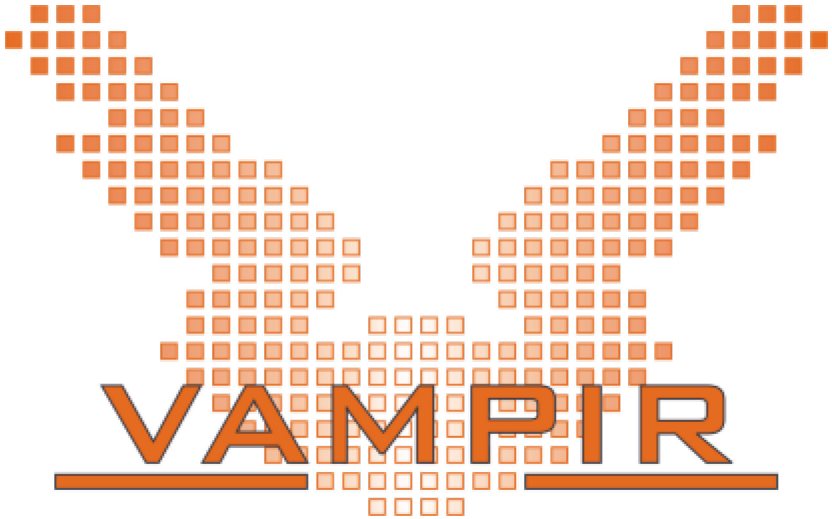
Conclusion

- 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