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Center for Information Services and High Performance Computing (ZIH)

# Performance Analysis with Open MPI and VampirTrace

Ronny Brendel, Holger Brunst, Jens Doleschal, Matthias Jurenz, Andreas Knüpfer,  
Matthias Lieber, Holger Mickler, Hartmut Mix, **Matthias Müller**, Michael Peter,  
Matthias Weber, Thomas William, Wolfgang E. Nagel

Zellescher Weg 12

Willers-Bau A113

Tel. +49 351 - 463 - 39835

Matthias S. Mueller

([matthias.mueller@tu-dresden.de](mailto:matthias.mueller@tu-dresden.de))

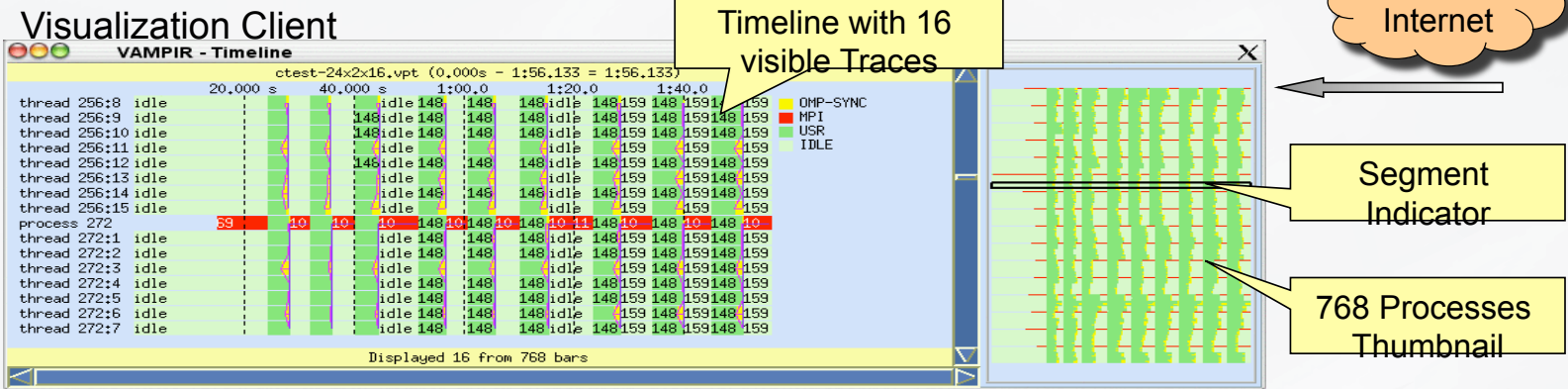
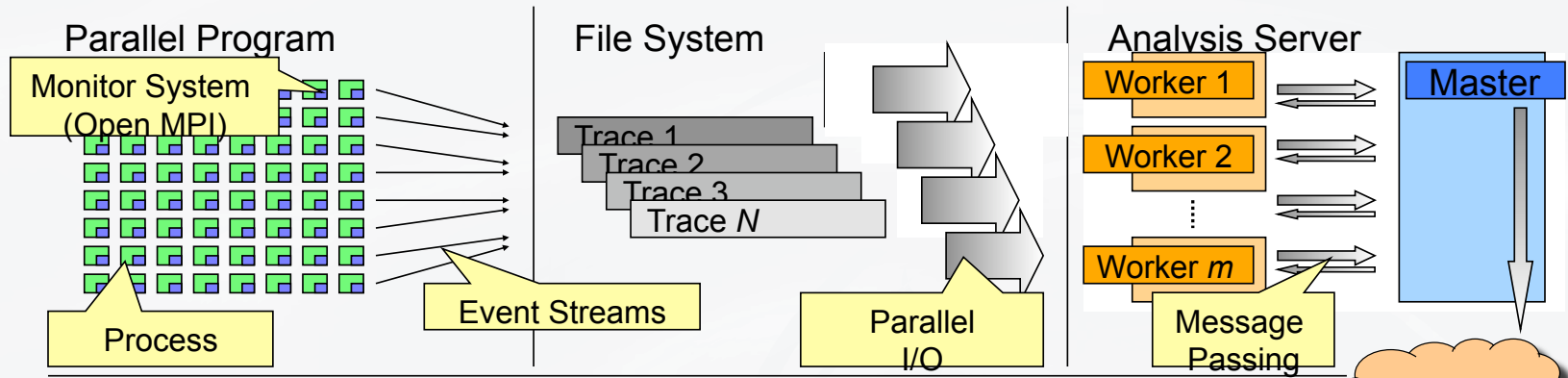


## Motivation

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- Parallel programming is about performance!
- Scaling to thousands of cores is required
- You need a decent MPI implementation, e.g. Open MPI
- You also need a ready-to-use performance monitoring and analysis tool

# Vampir performance analysis workflow



## VampirTrace

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- VampirTrace 5.x,y supports OTF as trace format
- Uses the PMPI interface
- Library implemented in collaboration with FZ Juelich, Univ. Oregon and University of Tennessee
  - OTF (developed with the TAU team at Univ. Oregon)
  - Epilog MPI wrappers (FZ Juelich)
  - Hardware performance counters (PAPI)
- Integrated in Open MPI v1.3 or later
- Available as open source under BSD license:  
<http://www.tu-dresden.de/zih/vampirtrace>



## Design of Open Trace Format

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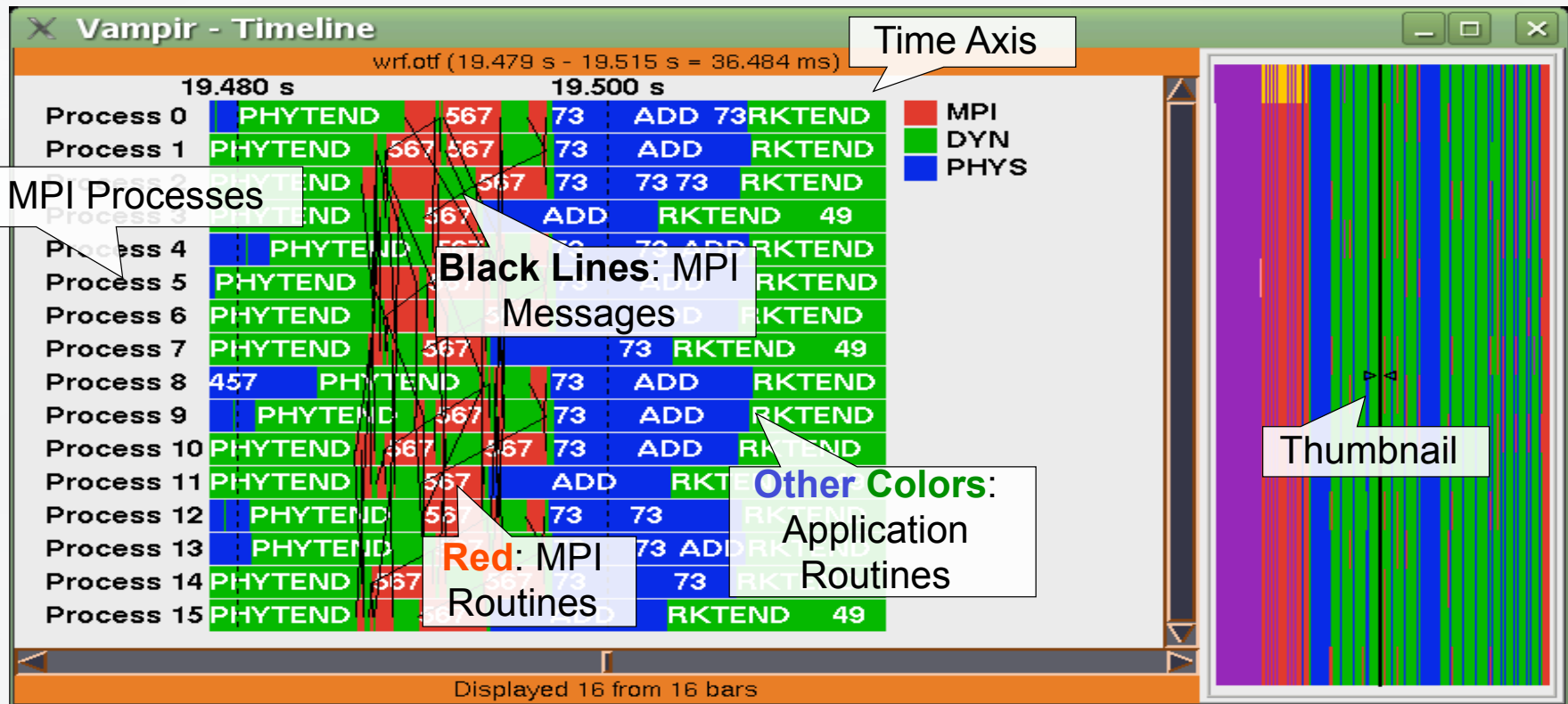
- Design of OTF is directed at 3 objectives:
- **Openness**
  - open format defines record types and file structure so that OTF traces can be generated and read correctly
  - external wishes will be considered .. just talk to us!
- **Flexibility**
  - efficiently selective access is supported
- **Performance**
  - is determined by how efficient & fast OTF trace query and manipulation can be done
  - parallel I/O

## Tools using the Open Trace Format

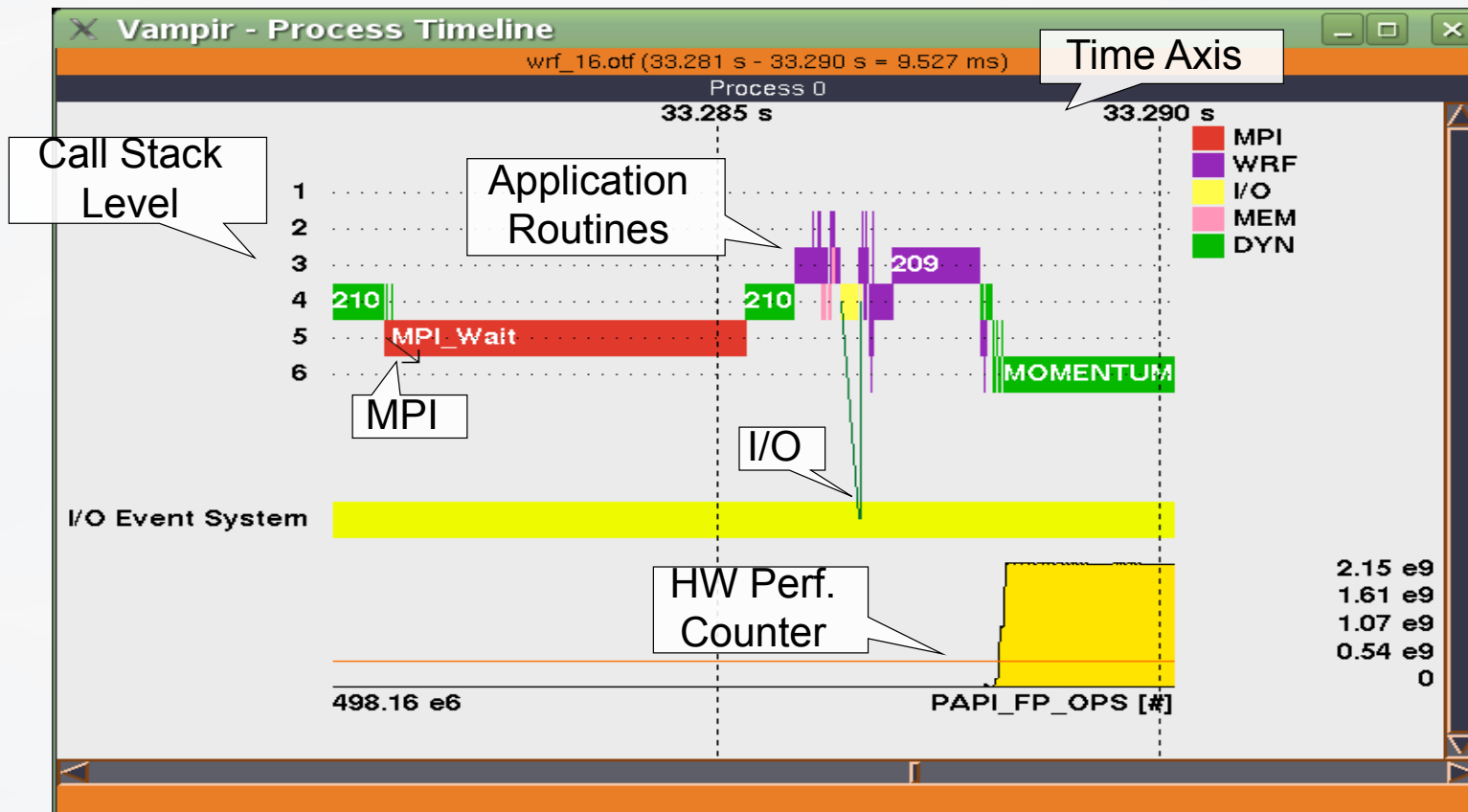
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- OTF profiler (comes with latest VampirTrace)
- Vampir
- Scalasca
- TAU
- Open SpeedShop
- Microsoft Windows Compute Cluster Environment

# Most prominent displays: Global Timeline

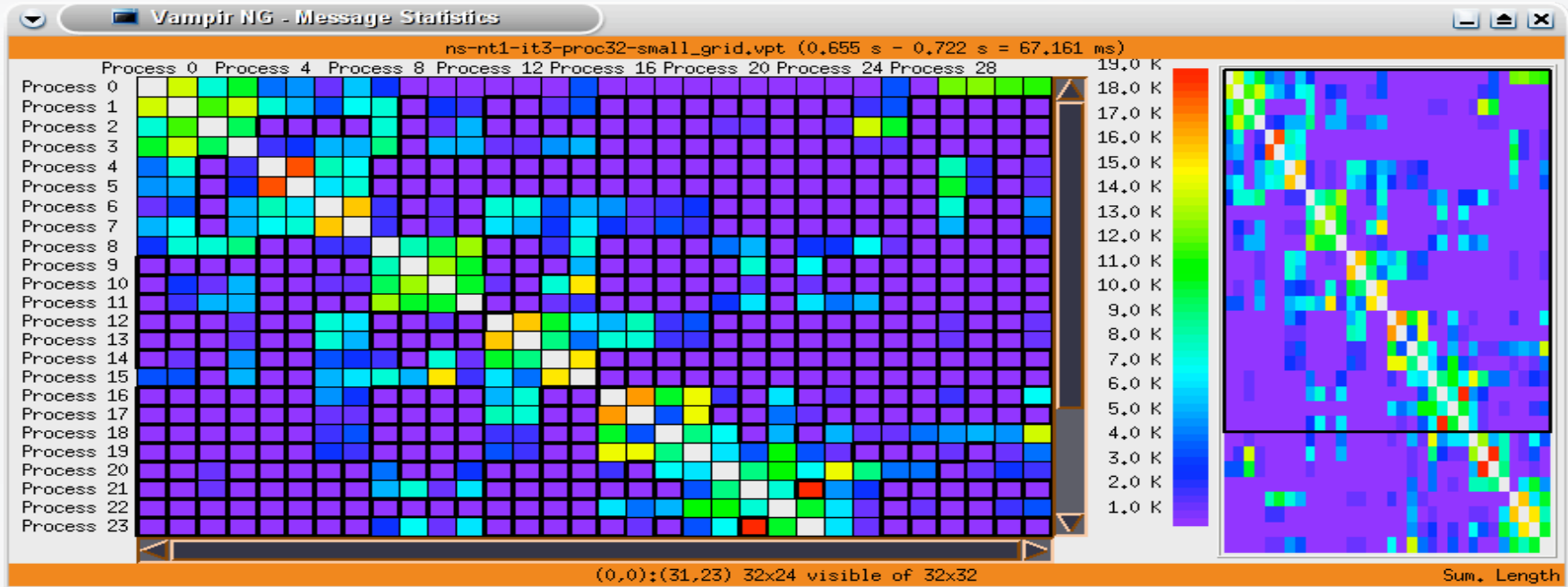


# Most prominent displays: Single Process Timeline



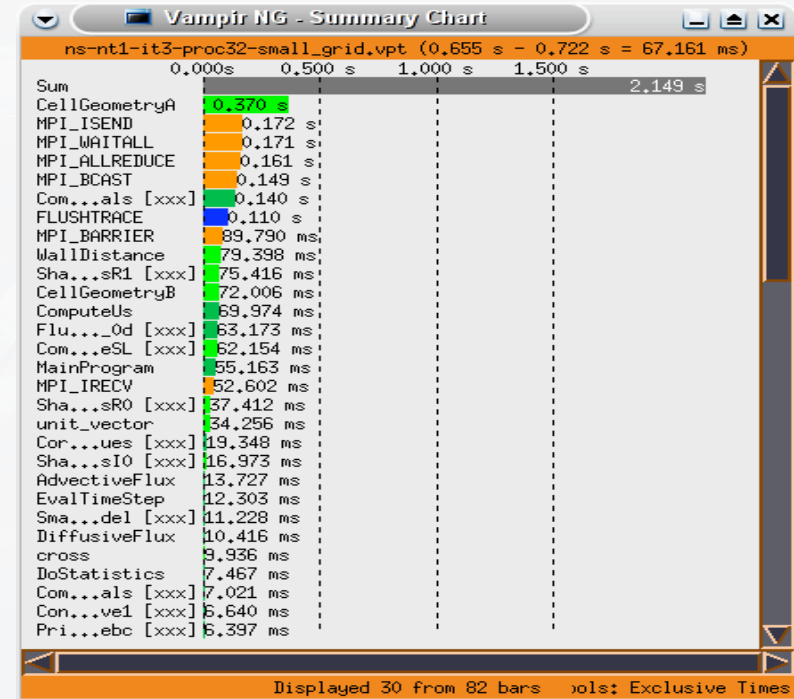
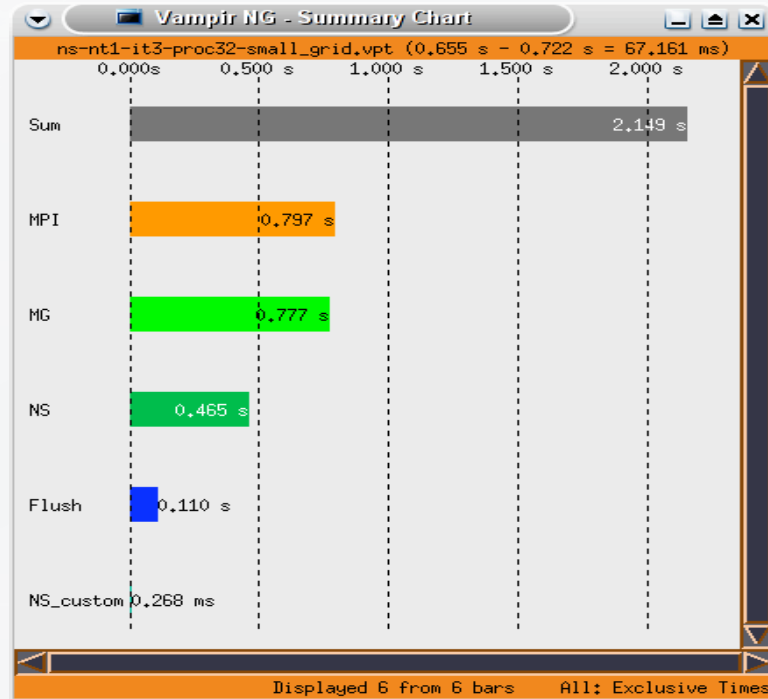


# Vampir Displays - Message Statistics



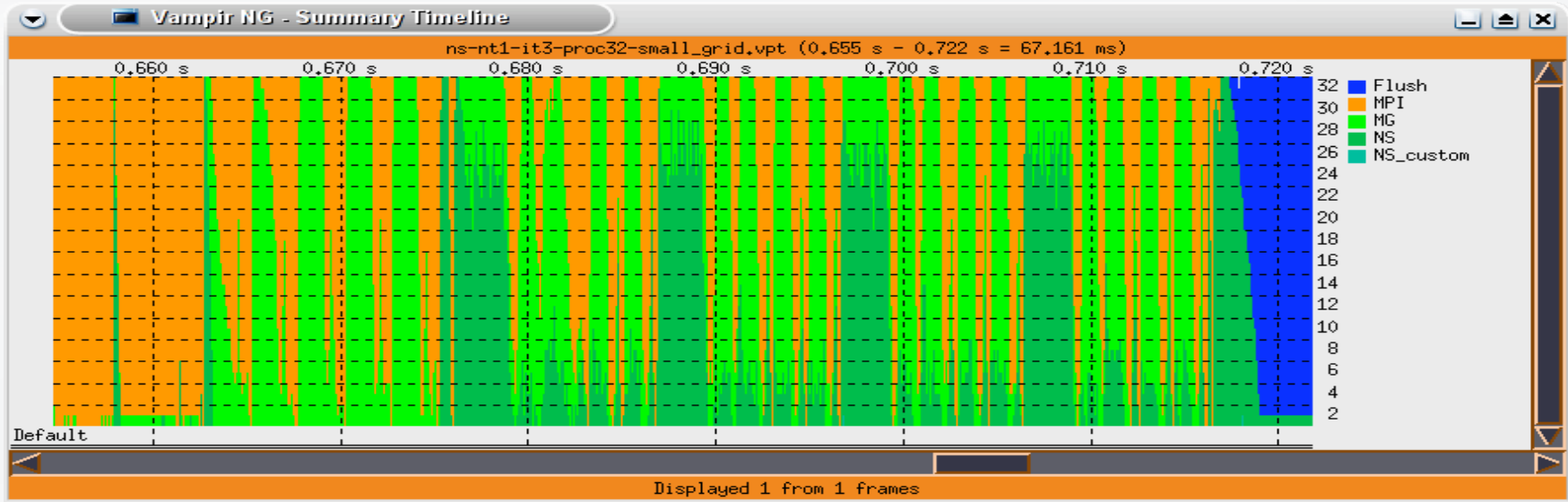
Message Statistics with Thumbnails

# Vampir Displays - Summary Chart



Grouped / Comprehensive Function Statistics

# Vampir NG Displays - Summary Timeline





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# A Tour Through Typical Performance Phenomena Seen With Vampir

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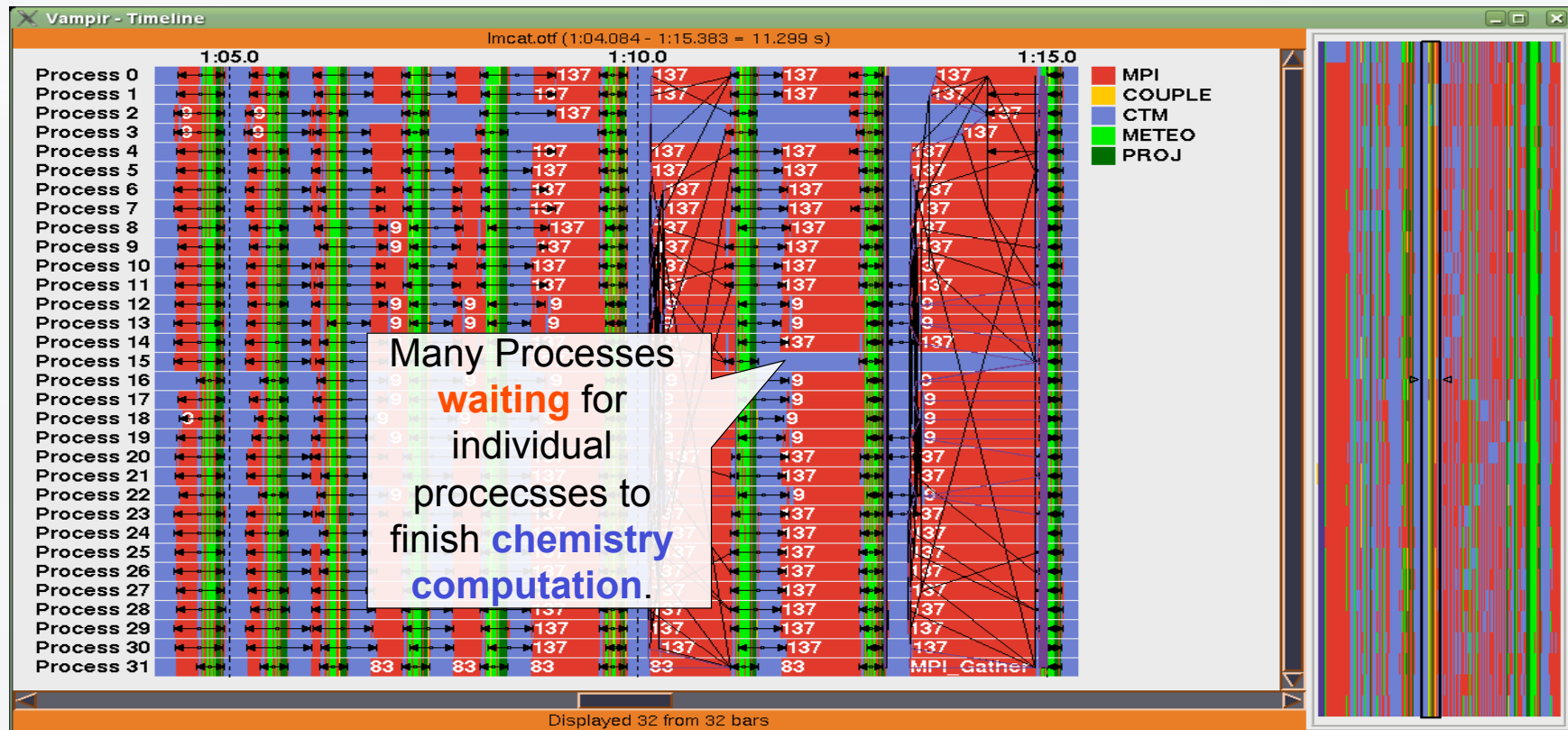
Tel. +49 351 - 463 - 39835

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# LM-MUSCAT Air Quality Model: Emerging Load Imbalance

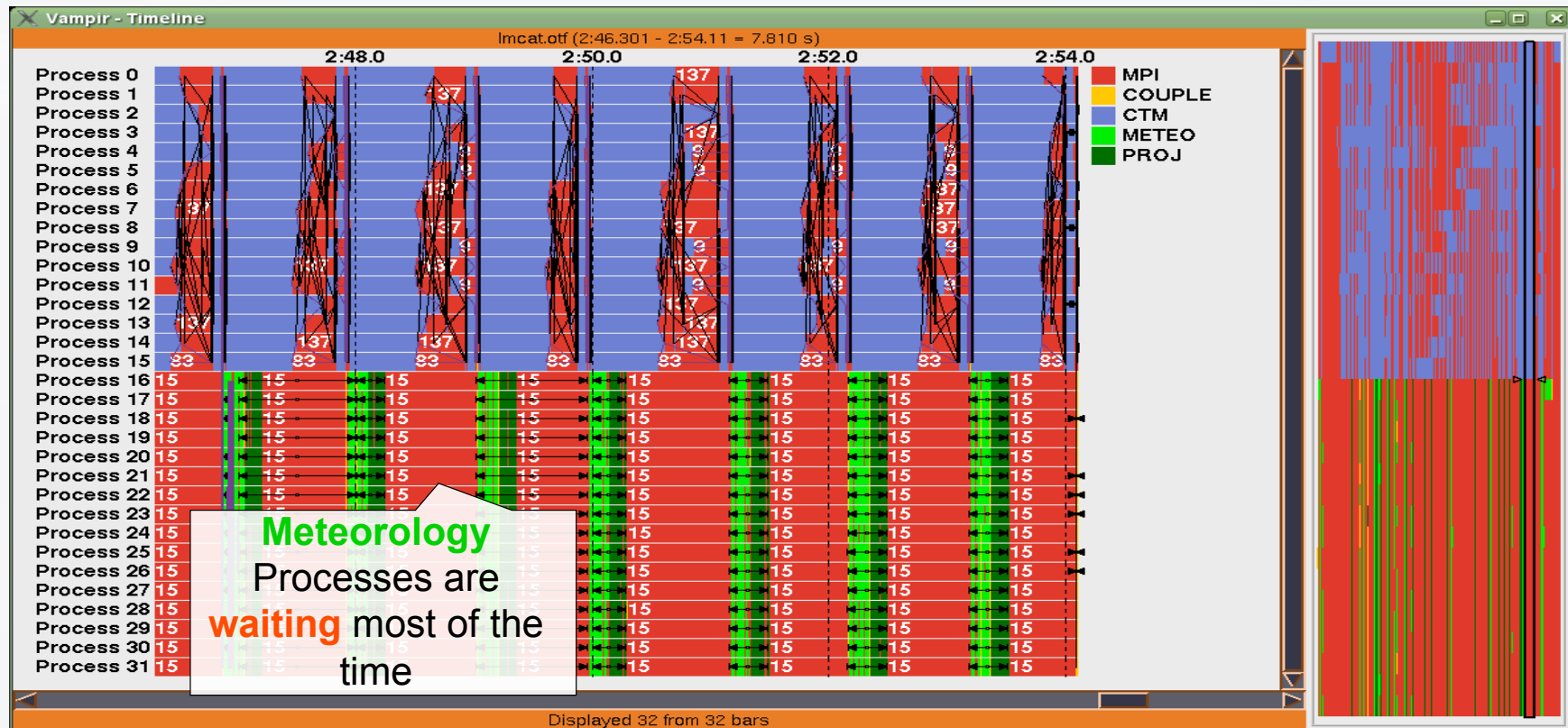


# LM-MUSCAT Air Quality Model: Emerging Load Imbalance

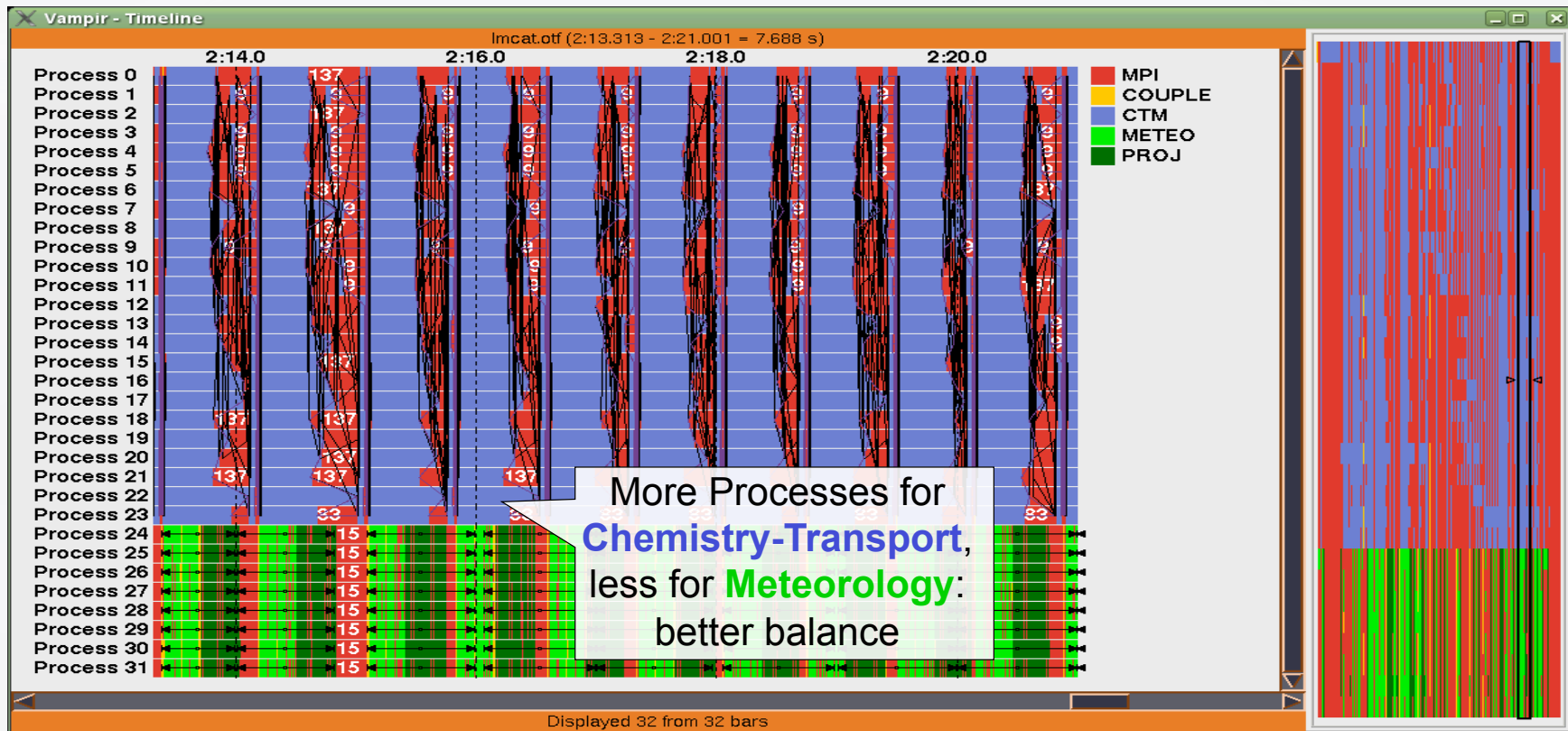


Examine the runtime  
behavior of the  
Application

# LM-MUSCAT Air Quality Model: Bad Processor Partitioning

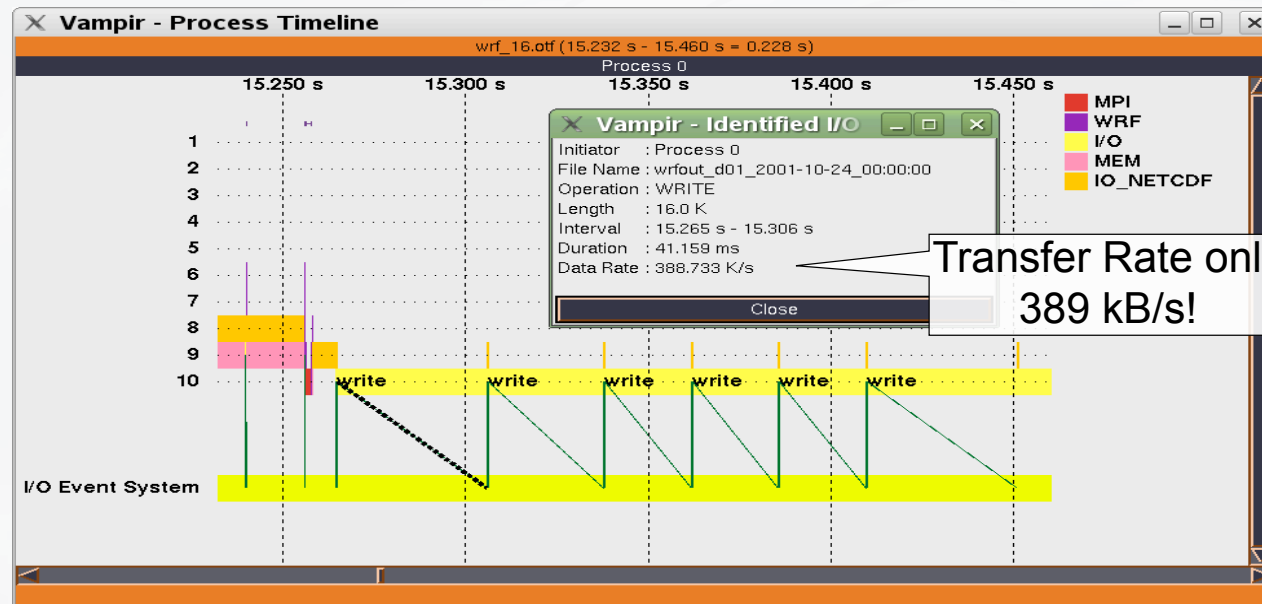


# LM-MUSCAT Air Quality Model: Good Processor Partitioning



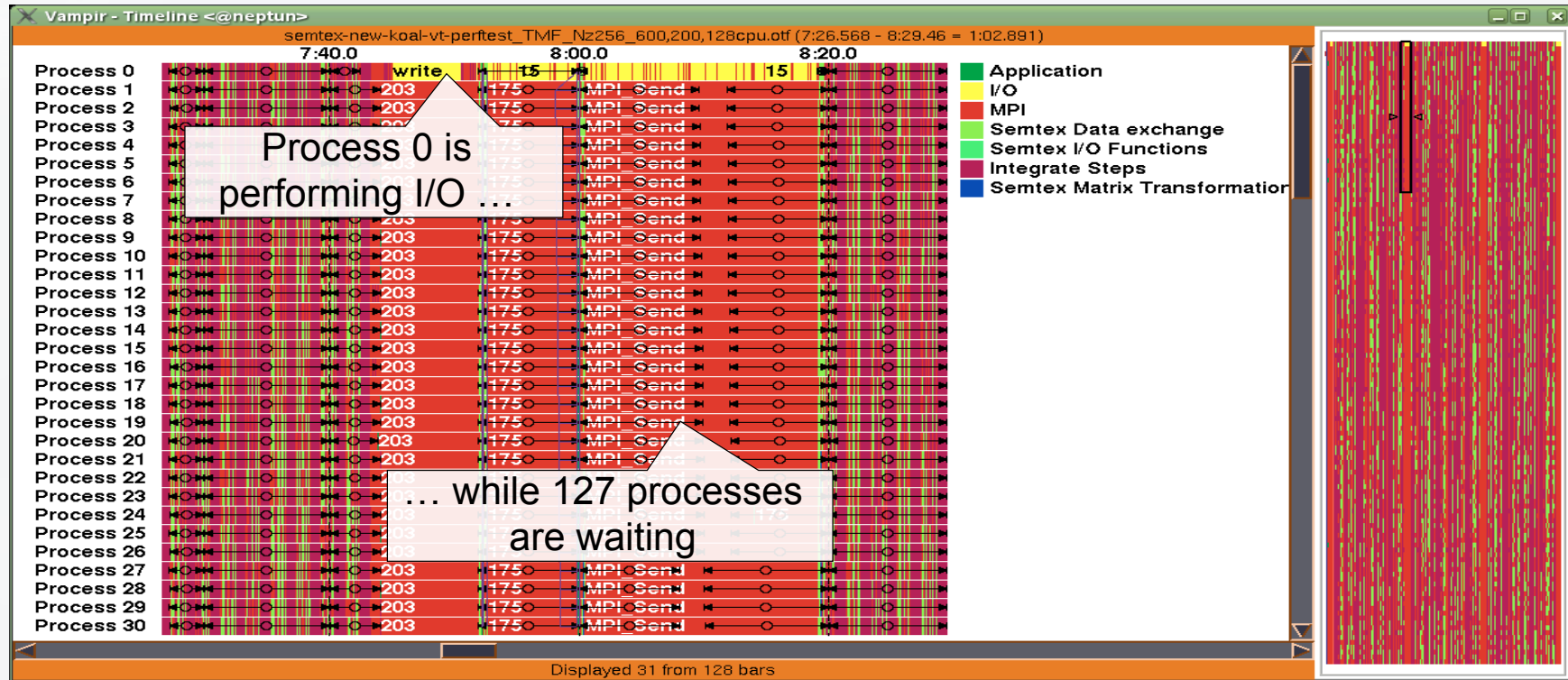


# WRF Weather Model: Low I/O Performance





# Semtex CFD Application: Serial I/O Leads to Waiting Times



# WRF Weather Model: Hybrid MPI/OpenMP - Idle Threads

