TECHNISCHE UNIVERSITÄT DRESDEN

DRESDEN concept

TU Dresden, Center for Information Services and HPC (ZIH)

ALWAYS ON?

ENVISIONING FULLY-INTEGRATED PERMANENT MONITORING IN PARALLEL APPLICATIONS

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VI-HPS 10th Anniversary Workshop, Seeheim, 2017-06-23

Past Achievements: Score-P Community Software

Since 2007/2009 a group of VI-HPS partner institutions jointly develop and maintain the Score-P and OTF2 software packages for parallel runtime monitoring and recording

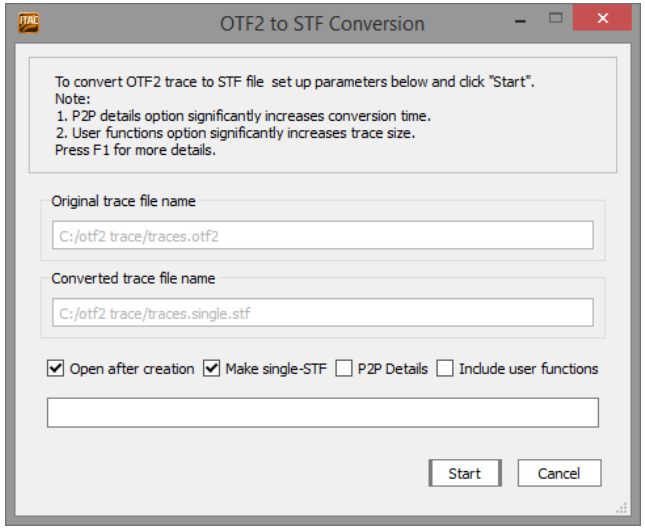
Score-P
Scalable performance measurement infrastructure for parallel codes

OTF2

- Many features
- Used worldwide

Thank you very much, dear partners!

Lately, the Intel Trace Analyzer supports OTF2 traces!



See https://software.intel.com/en-us/node/561577 and https://software.intel.com/en-us/node/684660 for the screenshot.

Who should tell about parallel performance?

Who offers parallel performance?


Various parallel programming models -- they give no insight into parallel performance


Hardware -- exposes some information but indirectly


Parallel libraries -- they tell nothing about performance


Applications -- some give a high-level performance report

Who tells about performance?

- Dedicated third-party tools
- Need to support exactly your combination of language, parallel model(s), and architecture(s)
- Few standards across tools
- Rather complicated to use

Without third-party tools one has **no clue** if it is running fast or efficient!

Let's compare to something slightly more usable …

From https://de.wikipedia.org/wiki/Datei:Mazda6_Typ_GJ_2.0_SKYACTIV-G_165_I-ELOOP_Sports-Line_Cockpit_Kombiinstrument_Tacho_beleuchtet_Nacht.jpg under Creative Commons license by Kickaffe (Mario von Berg)

- How fast is the car?
- How efficient is the car?
- Is something wrong?

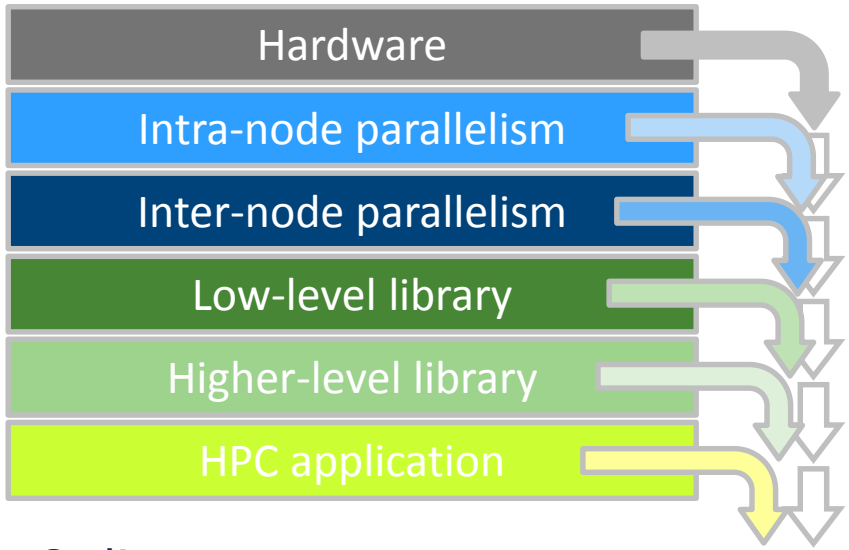
The usual "instrumentation" and displays in a car

- Speedometer, RPM meter, Odometer, Fuel mileage*
- Green, yellow, red indicator lights (a.k.a. "idiot lights")

- No special skills to read it
- No third-party tools needed
- Basically the same for Volkswagen, BMW, Ford, … (bear with non-SI units)
- Online, not post-mortem

Vision for the Future of Parallel Performance Monitoring

- Every layer comes with integrated performance reporting
- Define metrics relevant on the current level
- Pass on lower-level data



- Always on, no off switch!

https://commons.wikimedia.org/wiki/File:On-Off_Switch.jpg
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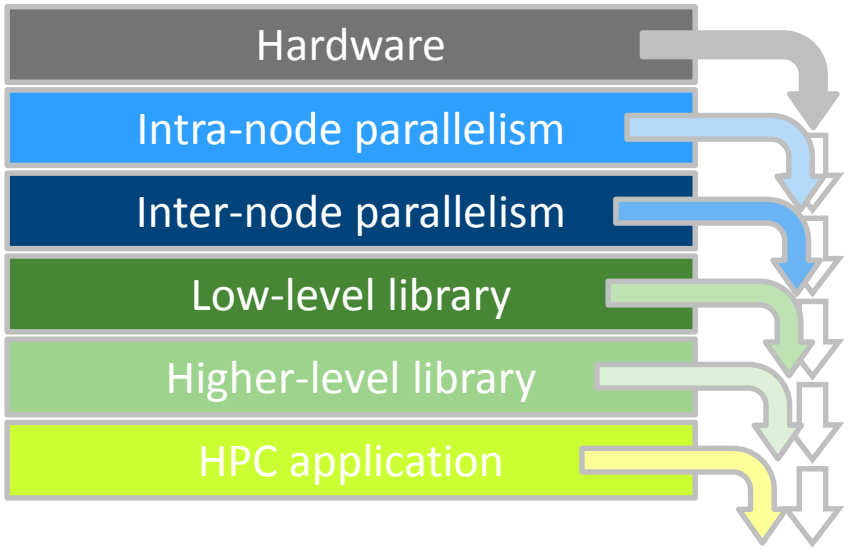
- Online
- Sensible overhead
- Little data by default, more on request
- Standardized APIs and formats

Example



CPUs offer HW counters*, GPUs offers CUPTI*

OpenMP: something based on OMPT*

MPI: something based on MPIT*

BLAS library: report vectors per second for certain vector lengths and operations

Multigrid library: report V-cycles per second

Application: report time to solution for so and so many degrees of freedom

* Selection required

- Always generate combined performance meters/report, not partially
- Provides conventional performance metrics plus new ones
- Allows to assess performance relationships
  - Flop/s go up but vector throughput stays constant => something is wrong

Exploring with the DASH PGAS library

dash
www.dash-project.org
Distributed Data Structures and Parallel Algorithms

- DASH is a high-level PGAS abstraction for parallel C++
  - Global data container classes with built-in data distribution information
  - Parallel template algorithms pay attention to distribution
  - Towards Exascale level
  - Slow global PGAS accesses vs. fast access to local parts
  - Slow individual remote access vs. fast bulk access
  - Implemented on top of MPI or GASPI

Is DASH being used efficiently?

- Introduce DASH-specific metrics about local and remote accesses
- Report results next to MPI/GASPI metrics, not intermixed or replacing them

(WP3.3 in *Smart DASH* project in the DFG SPPEXA program, 2017 - 2019)

How would this change the HPC tools landscape?

Possible advantages

- Performance always visible
  - Harder to ignore bad performance? ("idiot lights"?)
- Usability improves
  - Component maintainers do it, not external experts
  - It is always active, so issues show up earlier
- Interchangeable data formats?

Would "tools" as separate pieces of software go away?

- Maybe yes for the runtime part, but there will always be runtime infrastructure and special cases.
- Tools will stay around for sure for the analysis parts.
- New tools for analysis of higher-level components?

This should be the beginning of the discussion …

Disclaimer

- This is a personal opinion and vision how things should have been and should become
- Blame all crazy things and mistakes to the presenter
- All the hard work and the results and insights from it would have been impossible without the whole team at TU Dresden and many partners, of course!

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