Getting Results from Applications at Scale on Mira
Or “what to do when write(*,*) doesn’t cut the mustard”

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Agenda

• The challenge today
• What’s wrong with (the) Status Quo?
• What can tools do for me?
• Examples – live demos
Today’s Challenge

- Q: What is the impact of current trends in HPC on your application?
- Q: How can you make your science run well on the available system?
- A: Development.
Scalable science needs development tools

**HPC is beyond the turning point for developers**

- Print-style debugging cannot cope
- Systems too complex to understand performance
- Many existing tools fail to handle today’s systems
- HPC experts are overloaded

**Scalable systems need scalable tools**

- Tools enable software to fully exploit the hardware
- Scale does not have to be hard
- Scale does not have to be slow

**Allinea provides the solution**

- Allinea DDT and Allinea MAP
- Proven scalable, Super-Petascale-capable tools
- We understand what HPC developers need
Collaboration – National Labs

- Partnership to develop Petascale debugger with NVIDIA and Cray support for Titan
- Partnership on Full Scale debugging on IBM BlueGene P & Q
- Partnership with CEA French Atomic Energy Authority on scalable programming, CUDA and Allinea MAP
- European partnership to develop techniques and solutions which address the exascale challenges
- Partnership with BSC through its utilization of ARM technology to develop energy efficient HPC systems
Full speed debugging on Mira

- Scalable systems need *scalable* tools
  - Allinea and ANL collaborate to enable scalable Mira debugging
  - Millisecond responses at super-petascale
- Scalable systems need *stable* tools
  - Production quality at full scale
  - All debugging tasks/capabilities supported
- Ready to use at the extreme: **today**!
  - Regular Blue Waters and Titan sessions at the extreme
- **Don’t print it, debug it!**
The Allinea Environment

• At last: a modern integrated environment for the HPC developer

• Supporting the lifecycle of application development and improvement
  – Allinea DDT : Productively debug code
  – Allinea MAP : Enhance application performance

• Designed for productivity
  – Consistent integrated easy to use tools
  – Enables effective use of HPC resources and expertise
Allinea DDT – Debugging for HPC

**Simplicity**
- Applications are hard to understand
- Allinea DDT simplifies parallel information
- Allinea DDT highlights differences

**Completeness**
- Application fail for complex reasons
- Allinea DDT’s memory debugging makes random bugs reproducible
- Allinea DDT masters HPC datasets with filtering and visualization

**Scalability**
- Many tools fail to scale
- Allinea DDT has a scalable architecture and GUI
- Allinea DDT is full-size proven on the #1 system

**Efficiency**
- Bugs cost machine and developer time
- Allinea DDT is lightning fast – at any scale
- Allinea DDT’s offline mode finds bugs whilst you sleep
Allinea DDT: Scalable debugging by design

- **Where did it happen?**
  - Allinea DDT leaps to source automatically
  - Merges stacks from processes and threads

- **How did it happen?**
  - Some faults evident instantly from source

- **Why did it happen?**
  - Real-time data comparison and consolidation
  - Unique “Smart Highlighting” – colouring differences and changes
  - Sparklines comparing data across processes

- **Force crashes to happen?**
  - Memory debugging makes many random bugs appear every time
Machine access tough?

- Use offline mode: debug while you sleep
  - Set breakpoints, tracepoints from command line
  - Memory debugging
  - Record variables, stacks – crashes and breakpoints

- Submit and forget
  - Post-mortem analysis
  - HTML/plain text

- Example:

  ddt --offline foobar.html --n 4 myfusioncode
Key features at scale

- Top 5 features at scale
  - Parallel stack view
    - Ideal for divergence or deadlock
  - Memory debugging
    - Rare bugs happen more frequently at scale
  - Parallel array searching
    - Data is too large to examine manually
  - Process control with step, play, and breakpoints
    - Still essential
  - Offline debugging
    - Access to machine may be hard – try offline debugging instead
What can I do next?

Learn about Allinea DDT
- Ask a local expert
- Contact Allinea: support@allinea.com
- Introductory tours: http://www.allinea.com/webinars

How do I start on Mira?
- Add “+ddt” to your .soft file
- Compile your application with “-g” flag
- “ddt”