Dynamic Tracing
and the DTrace book

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Agenda

- Dynamic Tracing
- DTrace
- Latency
- Performance Introspection of Cloud Computing
- DTrace Book

- Please ask questions

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Dynamic Tracing is for Everyone

- DTrace is an implementation of Dynamic Tracing
  - One that has proven the concept
  - Has been used in large scale production for 5+ years
  - Provided examples of real world usage
- We may have confused the terms – they are separate
- If you never use DTrace, there is value from knowing what *Dynamic Tracing* is, to:
  - Learn what questions can conceivably be asked of the system
  - Rethink what performance observability is for – what is effective, ideal
- even if you end up not using DTrace
- Anecdote: “the most useful tool that never ran”
  - a blog post I’m writing (about har: hardware statistics tool)

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Dynamic Tracing

- The ability to instrument running software
- Collect timestamps and other info (workload specifics)
- Lets you create ideal metrics. Imagine one that has:
  - Black/white answers: either there is an issue, or there isn't
  - 100% reliability
  - No expert interpretation required
  - No time consuming analysis required
- Large scale environments usually have numerous possible issues
  - ideal metrics let you quickly identify the ones that matter, and the ones that don't
- Given it is possible, it's worth considering the metrics – and can lead you to design better ones to start with
  - Break the mentality of "making-do" with what you are given
- Prototype with dynamic tracing, then bake-into the software

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DTrace

- Provides dynamic (and static) tracing
- Includes a rich set of actions, including data aggregations
- Currently is for:
  - Solaris-based OSes (Solaris 10+, Joyent SmartOS, Illumos, etc.)
  - Mac OS X 10.5+
  - FreeBSD 7.1+
  - Linux? http://www.crisp.demon.co.uk/blog/ http://crtags.blogspot.com/
- Production safe; in use since 2005
- User-land and kernel-land tracing
- C & awk inspired language – easy to learn (the language)

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Demo

- DTracing MySQL…

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Latency

- A primary measure of application pain
  - When measured as a synchronous component of the workload
- Often not readily available when you want it: IOPS/ throughput instead
- Easy to get with DTrace
- Either event by event, or summaries
  - Averages lose data; DTrace can provide the full distribution
- Locate the source of latency from the application down to the disk devices

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Latency Drill Downs

Trace at each layer, for example, for disk I/O:

- Application
- Library
- System Calls
- Thread Scheduler
- VFS
- ZFS/UFS (and FS internals)
- sd
- SAS driver
- PCI driver

Any of these can be a source of latency

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Performance Introspection of Cloud Computing

- Steps performed during a recent investigation of customer latency of a web app (as an example):

1. Located latency in Apache/PHP: connect()s to MySQL (DTrace)
2. Showed latency was not during the queries (DTrace)
   - Which saved time: investigating query-based latency was set aside for now
3. Showed latency was not CPU dispatcher queue (DTrace)
4. Found suspicious counters: tcpListenDrop on server (netstat)
5. Showed Apache connects were dropped on server (DTrace)
6. Showed TCP was retransmitting these on client (DTrace)
7. Showed tcpListenDrops due to tcp_conn_req_max_q (DTrace)
8. Showed connection queue length in realtime (DTrace)
9. Showed application was not tuning accept() backlog (DTrace)

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Demo

- DTracing TCP…

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DTrace Changes Everything

- I spent most of my time using DTrace
- Other tools can provide clues and suggestions, but DTrace lets me confirm and move on
  - Not just for performance; also for confirming that applying patches are worthwhile, to avoid downtime when restarting apps
- If you told me before DTrace, that some new tool would be invented that I'd spend more time using than all other tools combined – I would have found it very hard to believe

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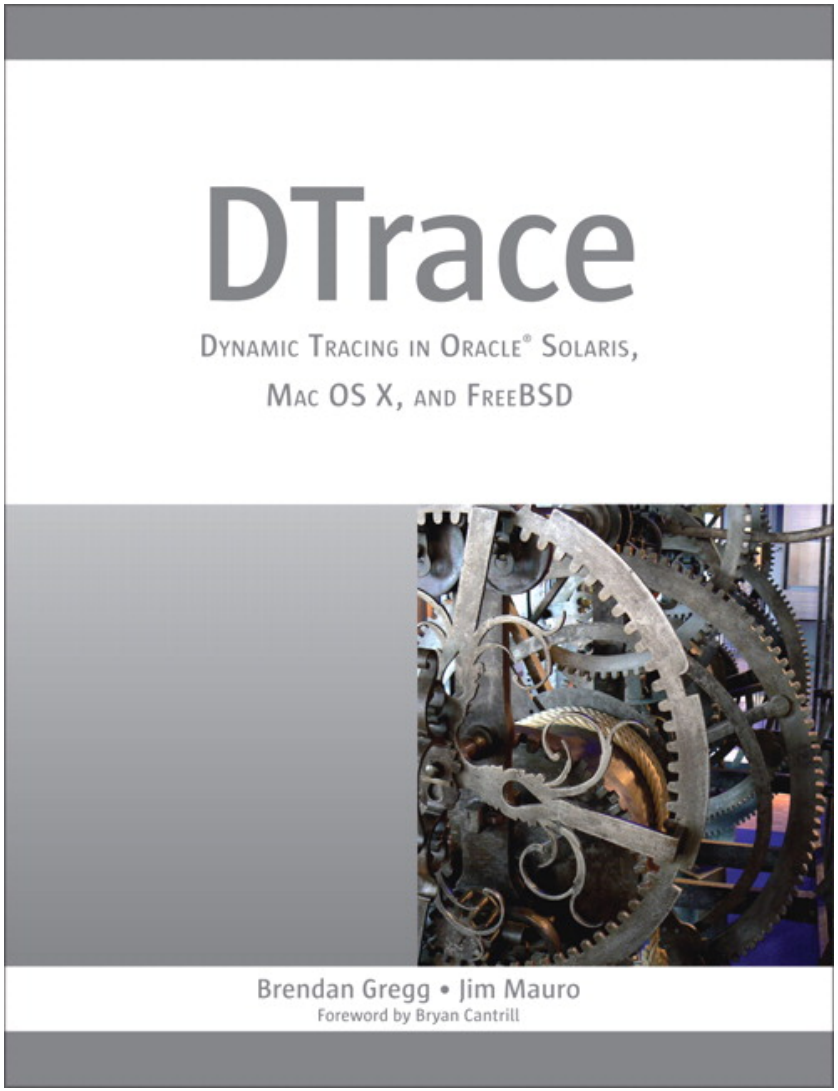
DTrace Book

Aim:

- Help people use DTrace
- Share new performance metrics and ideas

Contains:

- > 270 scripts
- > 230 one-liners
- Examples
- Strategies
- Checklists
- Case Studies



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DTrace Book Chapters

1. Introduction	18 pages
2. The D Language	32 pages
3. System View	100 pages
4. Disk I/O	140 pages
5. File Systems	108 pages
6. Network Lower Level Protocols	158 pages
7. Application Protocols	112 pages
8. Languages	114 pages
9. Applications	50 pages
10. Databases	34 pages
11. Security	26 pages
12. Kernel	54 pages
13. DTrace Tools	40 pages
14. Tips and Tricks	18 pages

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Topics Include

- CPU, Memory, Disk, Network
- SCSI, SATA, IDE, SAS
- VFS, UFS, ZFS, HFS+, …
- sockets, IP, TCP, UDP, ICMP, Ethernet
- NFS, CIFS, HTTP, DNS, …
- C, Java, JavaScript, Perl, PHP, Python, Ruby
- Mysql, PostgreSQL, …
- Kernel, Apps, ..

Shows examples of tracing each: getting started

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DTraceToolkit

- In a way, the book's scripts constitute version 2!
- They can be downloaded from: http://www.dtracebook.com
- Now that the book is done, and I have (some) spare time back, I can get back to updating the DTraceToolkit

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More Info

- http://www.dtracebook.com — All book scripts and sample chapter
- http://dtrace.org — Many dtrace blogs
- http://dtrace.org/blogs/brendan — My work blog
- http://bdgregg.blogspot.com — My personal blog
- http://www.brendangregg.com/dtrace.html — My DTrace page
- http://www.youtube.com/joyent — Short perf talks
- http://www.joyent.com — Company homepage

@brendangregg on twitter

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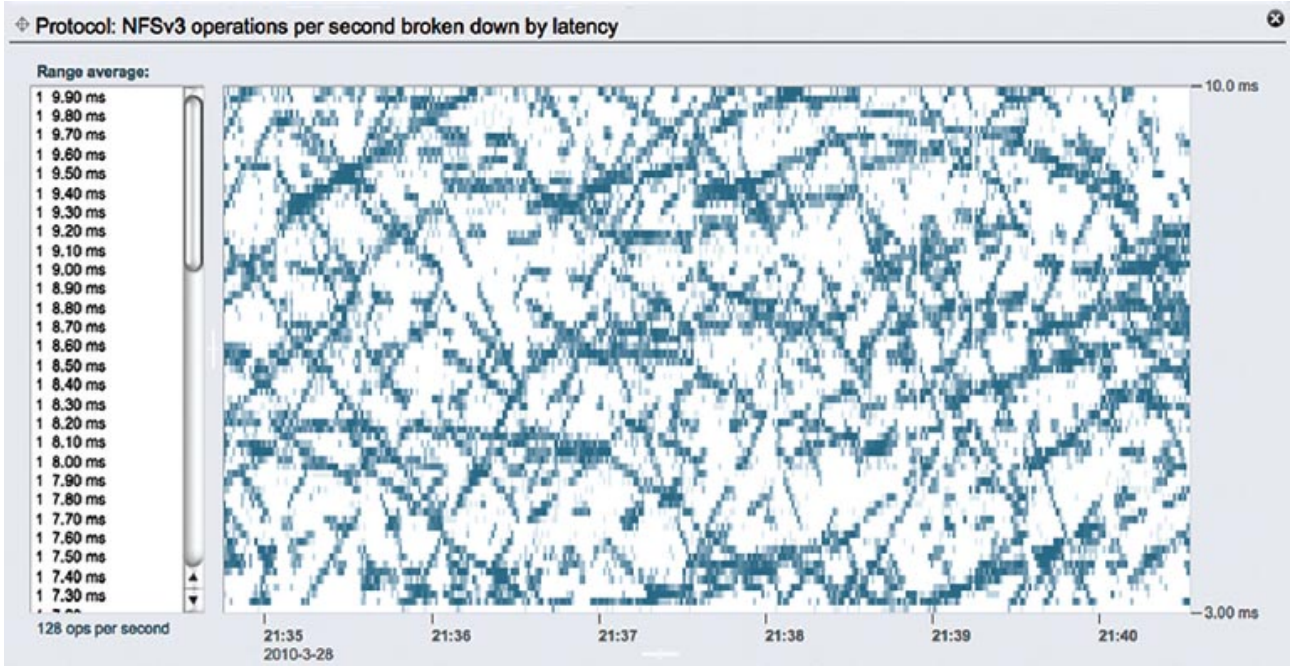
Extra Info – DTrace-Based Latency Heat Map

- "Visualizing System Latency", CACM, July 2010



- http://cacm.acm.org/magazines/2010/7/95062-visualizing-system-latency/pdf

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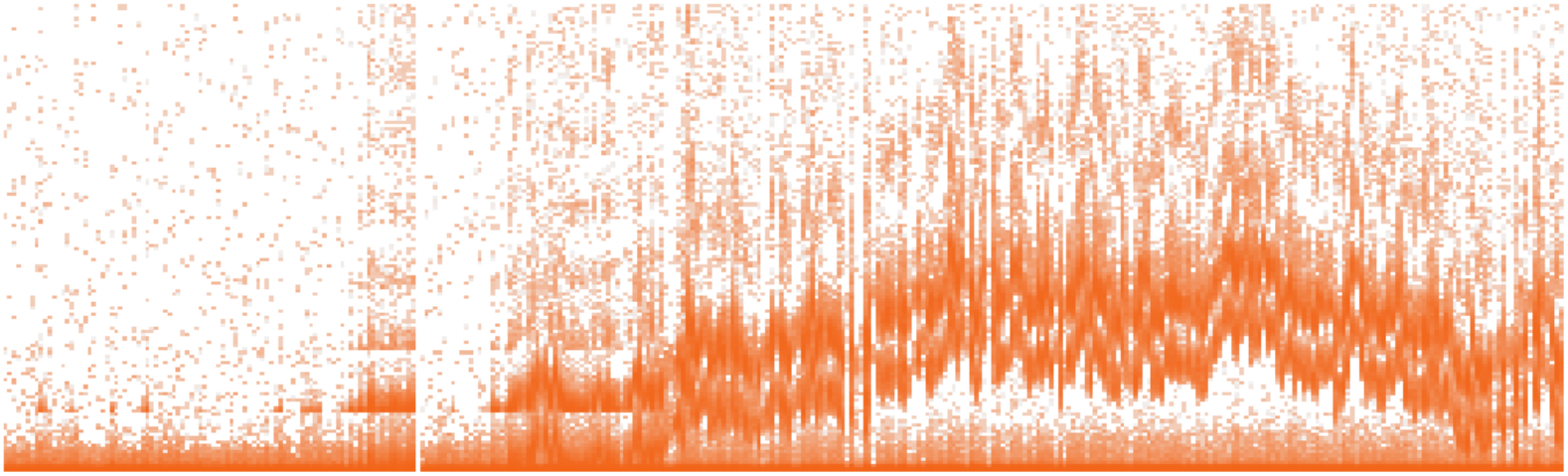
Extra Info – DTrace-Based Cloud Analytics



- http://dtrace.org/blogs/brendan/2011/03/14/mysql-query-latency-with-the-dtrace-pid-provider/
- http://dtrace.org/blogs/brendan/2011/01/24/cloud-analytics-first-video/
- http://dtrace.org/blogs/dap/2011/03/01/welcome-to-cloud-analytics/