Google-Wide Profiling: A Continuous Profiling Infrastructure For Data Centers

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Agenda

• What is continuous profiling?
• Infrastructure
• Collector
• Profiles
• Symbolization
• Profile Storage
• User Interface
• Reliability Analysis
• Questions
Continuous Profiling

- GWP is a continuous profiling infrastructure for data centers & provides performance insights for cloud applications
- The applications of these profile ranges from platform affinity measurements and identification of platform – specific micro architectural peculiarities
Infrastructure of GWP
GWP collector

• GWP samples in two dimensions. At any moment, profiling occurs only on a small subset of all machines in the fleet, and event-based sampling is used at the machine level.

• Each event sampling rate is chosen high enough to provide meaningful machine-level data while still minimizing the distortion caused by the profiling on critical applications.
Profiles and profiling interfaces

• Collects two categories of profiles:
  ➢ Whole – machine
  ➢ Per – process

• Users without root access cannot directly invoke most of the whole – machine profiling systems, so lightweight daemons are deployed on every machine to let remote users to access the profiles
Symbolization

• To provide meaningful information profiles must correlate to source code
• The code is not available offline and can no longer be symbolized
• It’s too resource intensive and sometimes impossible for applications whose source is not ready. The alternative is to permanently store binaries that contain debug information before they are stripped
Profile storage

- To make the data useful and accessible, the samples are loaded into a read only dimensional database that is distributed across hundreds of machines.
- The database supports a subset of SQL like semantics.
- Most queries are seen frequently, so the profile server uses aggressive caching to hide database latency.
User Interfaces

• GWP deploys a webserver to provide a user interface on top of the profile database
• It makes it easy to access profile data and construct ad hoc queries for the traditional use of application profiles
• Various views:
  ➢ Query view
  ➢ Call graph view
  ➢ Source annotation
Reliability analysis

• To conduct continuous profiling on datacenter machines serving real traffic, extremely low overhead is paramount, so we sample in both time and machine dimensions

• Two indirect methods are to evaluate the soundness of applications’ profiles
  - Study the stability of aggregated profiles using different metrics
  - Correlate profiles with the performance data from other sources to cross-validate both
The number of samples and the entropy of daily application – level profiles. The primary y-axis (bars) is the total number of profile samples. The secondary y-axis (line) is the entropy of the daily application – level profile.
The Manhattan distance between daily application level profiles for various profile types

The correlation between the number of samples and the Manhattan distance of profiles
Questions?