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Broader and simpler LDMS data sampling

Lightning update

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Overview

1. Broader
   - ***Process metrics sampler*** without code instrumentation or SLURM plug-in
   - ***AMD GPUs*** (ROCM 4.x rdc sampler)
   - ***tx2mon*** (ARM SOC)
   - ***loadavg***
   - ***syspapi***

2. Simpler to deploy: ***dynamic & auto-adaptive***
   - Lustre: client, mdt, ost
   - TCP network data
   - LNET stats
   - AMD GPUs

Broader: per-process metrics: Who & Why

- Sampler(s) developed by Boston U, OGC, SNL
- Watch login nodes in detail
  - detect node misuse
- Watch complex jobs in detail
  - e.g.
    - tracking many-step automated builds
    - track through deeply scripted workflows, such as machine learning
- See what resources system services are consuming
  - e.g.
    - slurm launch steps
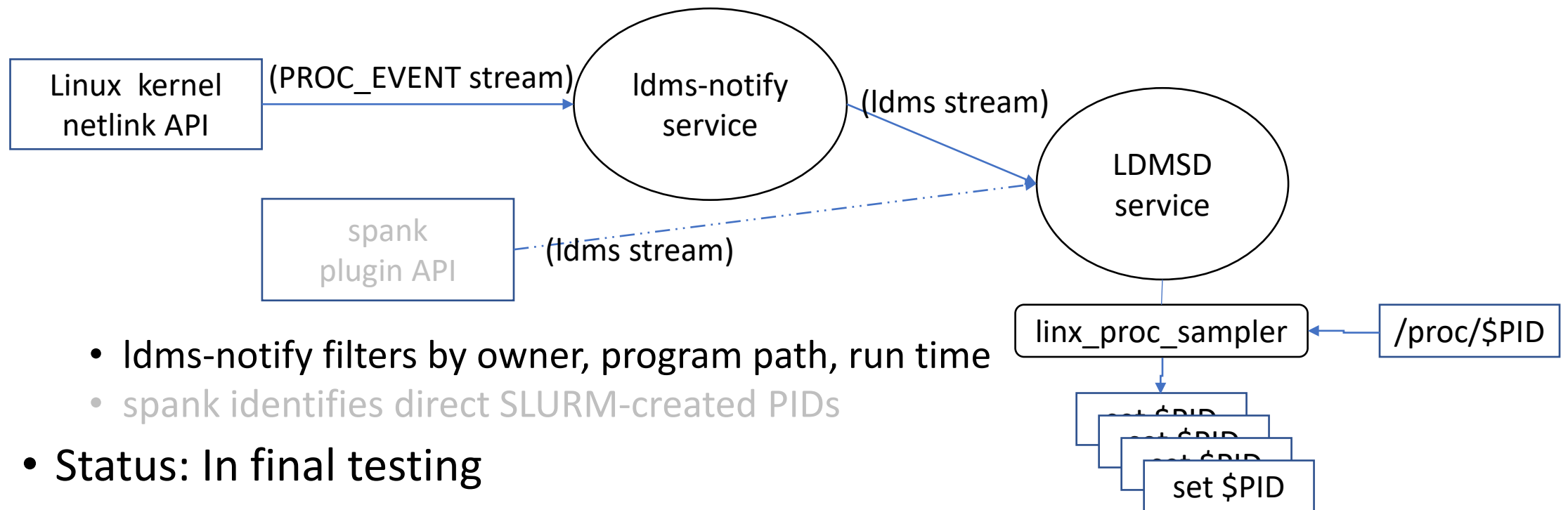
Broader: per-process metrics: What

- Command line text

- Executable full path

- 130+ from /proc/$PID/
  - RM job id, task ids if available
  - memory usages
  - CPU
  - I/O
  - file handle count, types
  - parent PID and PID, thread count
  - etc

JSON process sampler config:

```
{ "stream" : "slurm",
   "metrics" : [
"stat_pid", "stat_state", "stat_rss",
"stat_utime", "stat_stime",
"stat_cutime",  "stat_cstime",
"stat_num_threads", "n_open_files",
"io_read_b", "io_write_b",
"status_vmdata",

"status_rssfile", "status_vmswap",
"status_hugetlbpages",
"status_voluntary_ctxt_switches",
"status_nonvoluntary_ctxt_switches",
"syscall", "stat_comm", "cmdline"
   ]
}
```

Broader: per-process metrics: How

- Get process IDs from a Linux kernel channel (via ldms-notify daemon)
- Collect a metric set periodically per process
- How it works:

Linux kernel netlink API → (PROC_EVENT stream) → ldms-notify service → (ldms stream) → LDMSD service

spank plugin API → (ldms stream) → LDMSD service

linx_proc_sampler ← /proc/$PID

set $PID
set $PID
set $PID
set $PID

- ldms-notify filters by owner, program path, run time
- spank identifies direct SLURM-created PIDs

- Status: In final testing

Broader: rdc_sampler for AMD GPU

- Contributed by AMD, SNL
- ROCM 4.x RDC API
  - Default RDC_FI_ metrics:
    - GPU_CLOCK, MEM_CLOCK,
    - MEMORY_TEMP, GPU_TEMP,
    - POWER_USAGE,
    - PCIE_TX, PCIE_RX,
    - GPU_UTIL,
    - MEMORY_USAGE, MEMORY_TOTAL
  - Evolving with ROCM releases and hardware releases
    - Collaboration with SNL Advance Architecture testbeds team

Broader: tx2mon (ARM SOC)

- Contributed by HPE, SNL

- HPE ARM system-on-chip metrics
  - temperature, power, voltage, frequency (per core or bus)
  - CPU throttle events

- One metric set per socket

Broader: loadavg

- Contributed by SNL
- Turns /proc/loadavg into a metric set
  - These numbers are not trivially derivable from existing metric sets
- Data can be used to distinguish CPU saturation (/proc/stat) from the load numbers users see in *top* and similar utilities

Broader: syspapi

- Per-core hardware counters (machine specific registers)
  - PAPI used only for configuration file names of the counters
  - Kernel perf API used for data collection
- JSON configuration to select counters:

```
{    "schema": "syspapi-E5-2695.5", "events": [

"INST_RETIRED:ANY_P",  "CPU_CLK_THREAD_UNHALTED:THREAD_P",

"CPU_CLK_THREAD_UNHALTED:REF_XCLK",

"MEM_LOAD_UOPS_RETIRED:L2_MISS", "MEM_LOAD_UOPS_RETIRED:L3_MISS" ]

}
```

- Known conflict with HPC toolkit
  - SLURM 'feature' option has been used to pause syspapi at user's choice.
  - LDMS stream message to pause syspapi is available for testing.

Simpler to deploy

- New & updated samplers automatically manage sampling multiple similar devices and their dynamic disappearance or appearance.

- Administrators no longer need to invent site-specific schema names correlated to lists of device identifiers.

- Very large schemas (high column count CSV) encapsulating multiple devices are no longer needed.

Simpler to deploy: sampler specifics

- Main-line now includes LLNL Lustre plugins: client, mdt, ost sampling
  - Makes 1 set per mount point or device.
  - *lustre2_client* sampler is no longer recommended.
- TCP network data
  - New *procnet* sampler handles ports dynamically & ignores inactive ports.
  - Makes 1 set per port, skips set updates with no data changes.
  - Old *procnetdev* sampler works as before.
- LNET traffic
  - Implementation in *lnet_stats* now handles the case when all the mount points are temporarily missing.
  - Merge to main-line is pending.
- RDC sampler (AMD GPU) is refactored to make 1 set per GPU.

Broader & Simpler

- Samplers are improving
- Let us know what other samplers could work better for you
- Let us know what other samplers are needed