

# NSF/IUCRC CAC PROJECT

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## INTEGRATED VISUALIZING, MONITORING, AND MANAGING HPC SYSTEMS

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- Revisit PAPI (monitoring system status through hardware performance counters)
- Operating System Monitoring Tool

- Interface for using **low-level performance counters**
- Monitoring performance **events**, such as cache hit rates, TLB misses, floating-point operations, etc.
- **Limited hardware counters** (multiplexing), **overflow** (user-defined handlers)
- **Identify** the events to track
- **Deriving metrics** from the raw data

More **straightforward way** to monitor the operating system?

As easy as using *top*, *vmstat*, *iostat* etc.

- /proc - process information pseudo-file system in Linux
- Contains runtime system information, control and information centre for the kernel
- *top*, *vmstat*, *iostat* etc. call to files in this directory

*/proc/cpuinfo*: processor: type, model, performance etc.

*/proc/meminfo*: memory usage: physical and swap.

*/proc/diskstats*: I/O statistic

*/proc/net*: network status

- A cross-platform system monitoring tool
- Uses the *psutil* library to get information from system
- Works in client/server model, provides a **RESTful JSON API**

```
xps (Ubuntu 14.04 64bit / Linux 3.13.0-63-generic) - IP 192.168.0.5/24 Uptime: 1 day, 17:30:44

Intel(R) Core(TM) i7-4500U CPU @ 1.80GHz - 1.80/1.80GHz
CPU [|||||] 99.9% user: 97.9% nice: 0.5% MEM 28.1% active: 2.47G SWAP 0.0% LOAD 4-core
MEM [|||||] 28.1% system: 1.5% irq: 0.0% total: 7.71G inactive: 1.38G total: 7.91G 1 min: 1.66
SWAP [|||||] 0.0% idle: 0.1% iowait: 0.0% used: 2.17G buffers: 199M used: 0 5 min: 0.98
                                           free: 5.54G cached: 1.76G free: 7.91G 15 min: 0.68

NETWORK Rx/s Tx/s CONTAINERS 2 (served by Docker 1.7.1)
docker0 0b 0b
lo 0b 0b
h35fc066 0b 0b
h8e6ba8a 0b 0b
wlan0 19Kb 960Kb

Name Status CPU% MEM IOR/s IOW/s Rx/s Tx/s Command
dbgrafana_grafana_1 Up 16 mins 0.1 16.1M 0b 0b 0b 0b /usr/sbin/grafana-server --config=/etc/grafana/grafa
bgrafana_influxdb_1 Up 16 mins 0.1 16.3M 0b 0b 0b 0b /run.sh

TASKS 228 (731 thr), 9 run, 219 slp, 0 oth sorted automatically by cpu_percent, flat view

DISK I/O R/s W/s
sda1 0 0
sda2 0 374K
sda3 0 0

Dropbox RUNNING CPU: 4.9% | MEM: 0.3%
Python RUNNING

FILE SYS Used Total CPU% MEM% VIRT RES PID USER NI S TIME+ IOR/s IOW/s Command
/ (sda2) 197G 226G 85.5 0.0 7.13M 100K 22818 nicolargo 0 R 0:11.21 0 0 stress --cpu 4 -t 30
/boot/efi 3.38M 511M 66.6 0.0 7.13M 100K 22821 nicolargo 0 R 0:10.62 0 0 stress --cpu 4 -t 30
7.13M 100K 22820 nicolargo 0 R 0:10.18 0 0 stress --cpu 4 -t 30
7.13M 100K 22819 nicolargo 0 R 0:10.14 0 0 stress --cpu 4 -t 30

SENSORS
temp1 °C 27 22.1 1.8 2.67G 140M 3745 nicolargo 0 S 0:53.53 0 294K /usr/bin/perl /usr/bin/shutter
temp2 °C 29 9.0 11.4 2.49G 897M 6645 nicolargo 0 S 0:47.12 5K 157K /home/nicolargo/.dropbox-dist/dropbox-lnx.x86_64-3.8.8/dropbox /new
Physical id °C 65 4.9 0.3 240M 25.7M 7077 nicolargo 0 S 0:02.24 0 0 /usr/lib/firefox/firefox
Core 0 °C 63 3.8 2.8 1.60G 217M 3219 nicolargo 0 S 0:08.60 0 0 python -m glances
Core 1 °C 65 1.5 1.2 427M 93.4M 1987 root 0 S 0:51.84 0 0 /usr/bin/gnome-shell
Battery % 31 0.6 0.1 401M 7.42M 4128 nicolargo 0 R 0:02.61 0 0 /usr/bin/X :0 -background none -verbose -auth /var/run/gdm/auth-for
0.6 0.2 626M 14.6M 3041 nicolargo 0 S 0:12.63 0 0 zeitgeist-datahub
0.6 0.3 918M 20.2M 2744 root 0 S 0:00.52 0 0 /usr/lib/x86_64-linux-gnu/bamf/bamfdaemon
0.3 0.7 2.07G 53.4M 2072 rabbitmq 0 S 0:08.76 0 0 /usr/bin/docker -d --dns 8.8.8.8 --dns 8.8.4.4
0.3 0.2 468M 16.5M 3325 nicolargo 19 S 1:05.63 0 0 /usr/lib/erlang/erts-5.10.4/bin/beam.smp -W w -K true -A30 -P 10485
0.3 0.4 1.04G 34.6M 4299 nicolargo 0 S 0:01.60 0 0 /usr/lib/tracker/tracker-miner-fs
0.3 0.1 391M 10.1M 3258 nicolargo 0 S 0:00.52 0 0 /usr/lib/evolution/3.10/evolution-alarm-notify
0.3 0.1 355M 6.24M 3069 nicolargo 0 S 0:01.21 0 0 /usr/lib/telepathy/mission-control-5
0.3 0.0 0 0 173 root 0 S 0:08.60 0 0 /usr/bin/ibus-daemon --daemonize --xim
0.3 0.1 341M 4.64M 4133 nicolargo 0 S 0:00.72 0 0 kworker/2:2
0.3 0.0 39.6M 2.66M 3002 nicolargo 0 S 0:00.76 0 0 /usr/bin/zeitgeist-daemon
0.3 0.5 913M 39.9M 4010 nicolargo 0 S 0:04.69 0 0 dbus-daemon --fork --session --address=unix:abstract=/tmp/dbus-tj7X
0.3 0.6 474M 46.2M 9079 nicolargo 0 S 0:06.59 0 0 /usr/bin/python /usr/bin/terminator
0 /usr/lib/firefox/plugin-container /usr/lib/flashplugin-installer/li

Warning or critical alerts (lasts 3 entries)
2015-09-19 14:57:17 (ongoing) - CPU_USER (98.4)
2015-09-19 14:54:48 (0:00:20) - CRITICAL on CPU_USER (98.5)
2015-09-19 14:53:25 (0:00:24) - CRITICAL on CPU_USER (98.5)
```

### Monitoring **statistic of every CPU**

**total**: total CPU usage

**user**: percent time spent in user space

**system**: percent time spent in kernel space

**iowait**: percent time spent by the CPU waiting for I/O operations to complete

```
"percpu": [  
  {  
    "cpu_number": 0,  
    "guest": 0.0,  
    "guest_nice": 0.0,  
    "idle": 89.9,  
    "iowait": 0.4,  
    "irq": 0.0,  
    "key": "cpu_number",  
    "nice": 0.0,  
    "softirq": 0.1,  
    "steal": 0.0,  
    "system": 1.3,  
    "total": 10.1,  
    "user": 8.3  
  },  
  {  
    "cpu_number": 1,  
    "guest": 0.0,  
    "guest_nice": 0.0,  
    "idle": 89.7,  
    "iowait": 0.0,  
    "irq": 0.0,  
    "key": "cpu_number",  
    "nice": 0.0,  
    "softirq": 0.0,  
    "steal": 0.0,  
    "system": 1.5,  
    "total": 10.3,  
    "user": 8.8  
  },  
]
```



### Monitoring the **network interface bit rate**

**Rx:** receive bit rate

**Tx:** Transmit bit rate

```
"network": [  
  {  
    "cumulative_cx": 489530,  
    "cumulative_rx": 39360,  
    "cumulative_tx": 450170,  
    "cx": 15113,  
    "interface_name": "eth0"  
    "is_up": true,  
    "key": "interface_name",  
    "rx": 733,  
    "speed": 10485760000,  
    "time_since_update": 56.1  
    "tx": 14380  
  }  
],
```

### Monitoring the **disk I/O throughput**

**write\_bytes:** write bytes per second

**Read\_bytes:** read bytes per second

```
"diskio": [  
  {  
    "disk_name": "sda2",  
    "key": "disk_name",  
    "read_bytes": 0,  
    "read_count": 0,  
    "time_since_update": 56.1  
    "write_bytes": 94843904,  
    "write_count": 197  
  },  
]
```

Monitoring the **used and total file system disk space**

```
"fs": [  
  {  
    "device_name": "/dev/mapper/centos_nagios-root",  
    "free": 41763074048,  
    "fs_type": "xfs",  
    "key": "mnt_point",  
    "mnt_point": "/etc/resolv.conf",  
    "percent": 22.2,  
    "size": 53660876800,  
    "used": 11897802752  
  },  
]
```

Monitoring the **temperature of each core**

```
"sensors": [  
  {  
    "key": "label",  
    "label": "Core 0",  
    "type": "temperature_core",  
    "unit": "C",  
    "value": 32  
  },  
  {  
    "key": "label",  
    "label": "Core 1",  
    "type": "temperature_core",  
    "unit": "C",  
    "value": 29  
  },  
]
```



## GLANCES OVERHEAD

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- CPU Usage: ~12.5% when fetching data
- Memory Usage: ~25.43 MiB / 23.37 GiB, 0.11%
- Net I/O: ~117KB/query

DEMO

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DEMO



**QUESTIONS?/COMMENTS?**