

# Thinking and Practice on Linux System Performance

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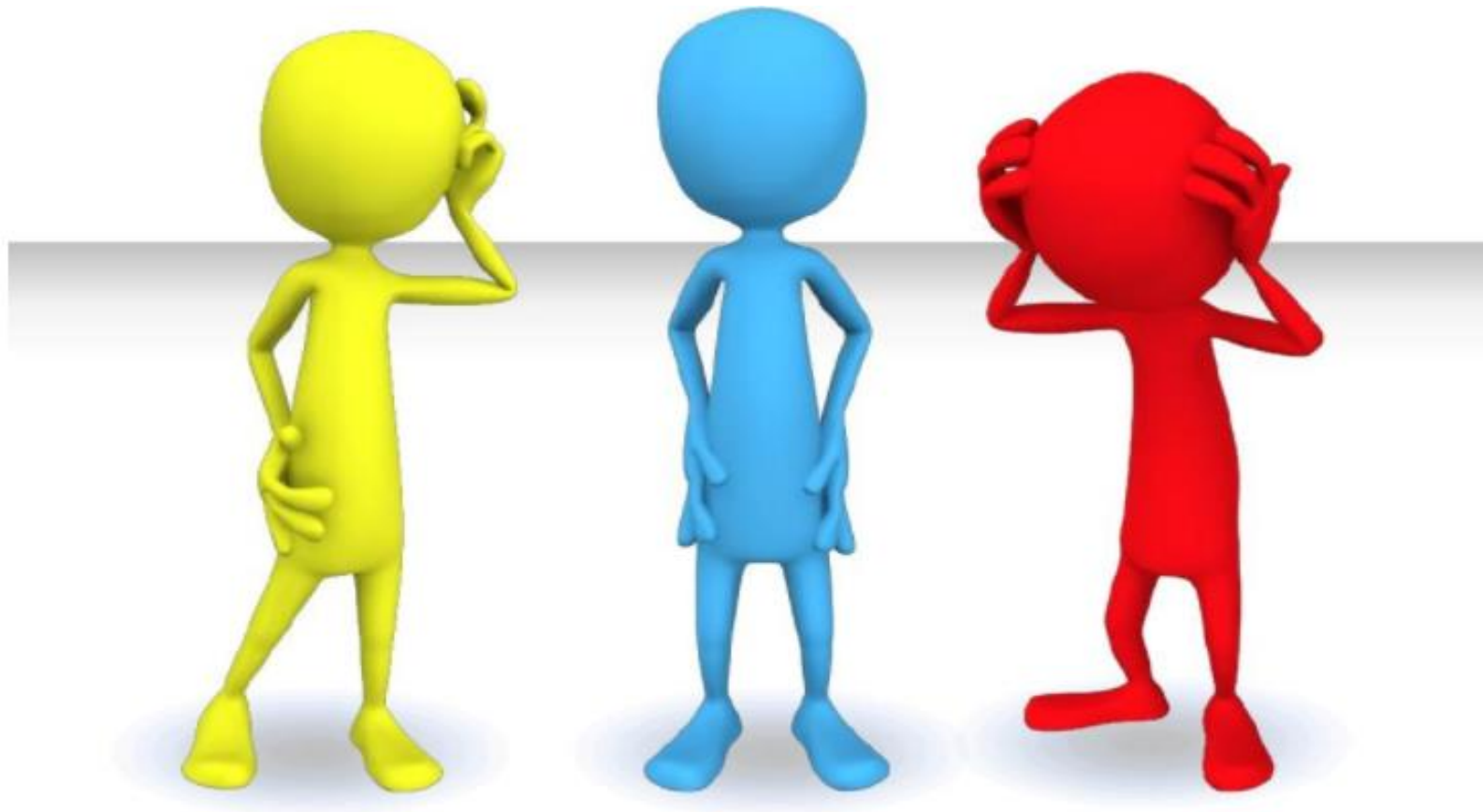
<http://www.linuxep.com>

LEP(Linux Easy Profiling)

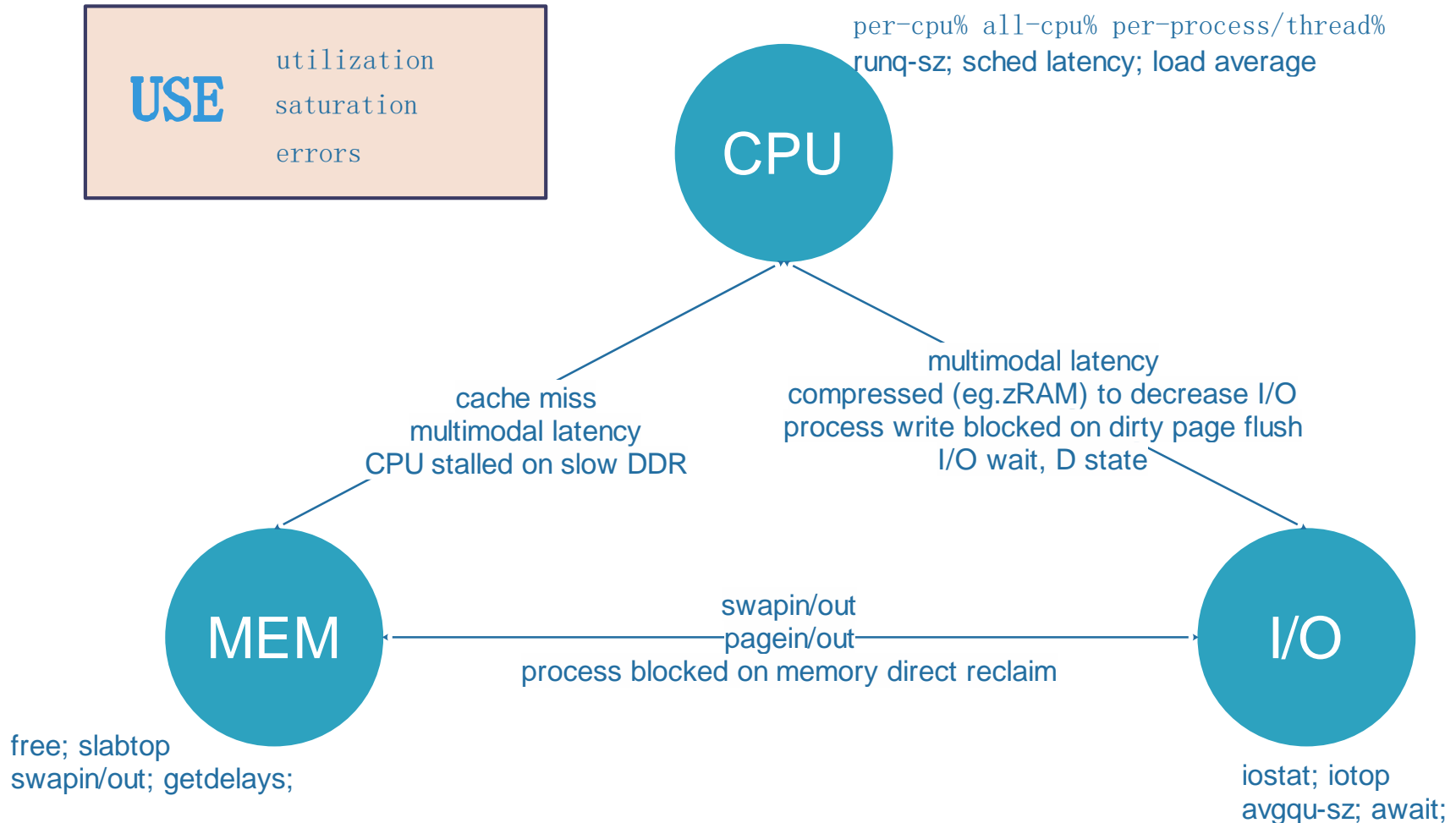
An open-sourced all-in-one toolbox  
for Linux/Android performance profiling & visualization



Life is hard  
So is performance profiling

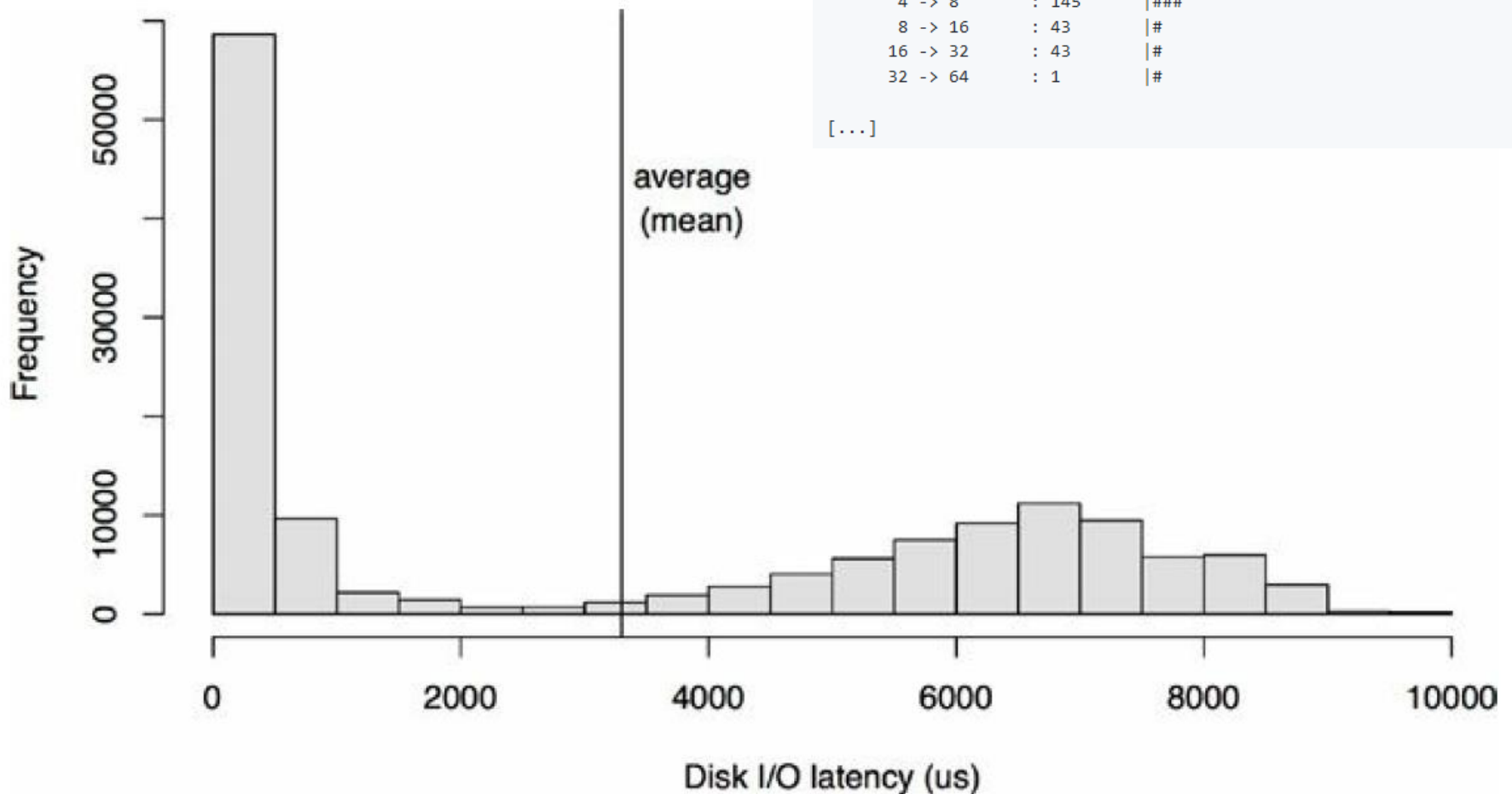


# CPU、Memory和I/O



# Typical Latency Profiles - Multimodal

## Multimodal Distribution



```
# ./iolatency -Q
Tracing block I/O. Output every 1 seconds. Ctrl-C to end.

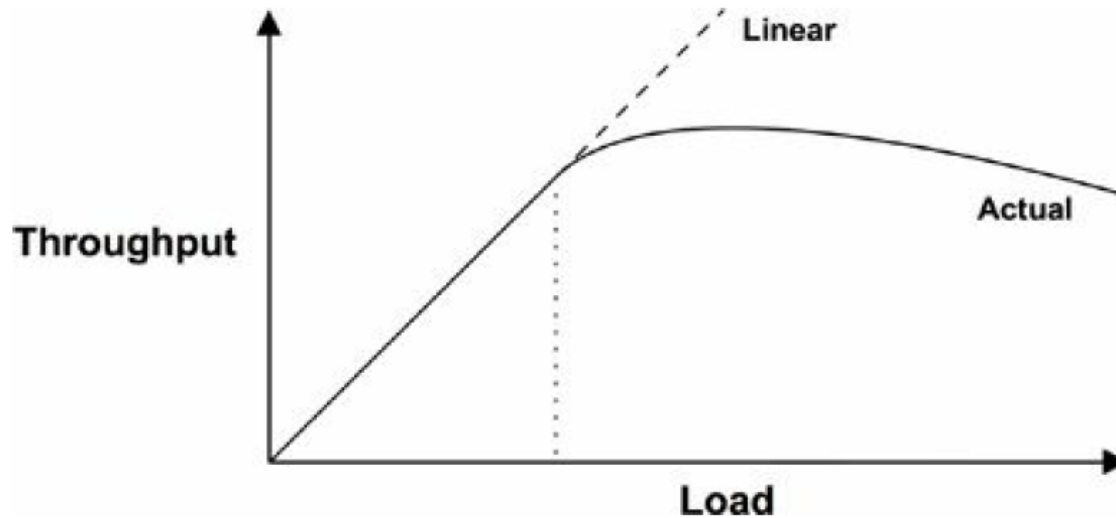
>=(ms) .. <(ms) : I/O      |Distribution|
0 -> 1         : 1913   |#####|
1 -> 2         : 438    |#####|
2 -> 4         : 100    |##|
4 -> 8         : 145    |###|
8 -> 16        : 43     |#|
16 -> 32       : 43     |#|
32 -> 64       : 1      |#|

[...]
```

# Typical Throughput Profile

Linear increasment -> *knee point/ non-linear increasment* -> *decrease*

Enough resources -> *resource contention* -> increased contention



# Massive Difficult

# Difficult



style inspired by [reddit.com/u/redct](http://reddit.com/u/redct)  
<http://www.brendangregg.com/linuxperf.html> 2017

# Show me



Linux experts

# Help me



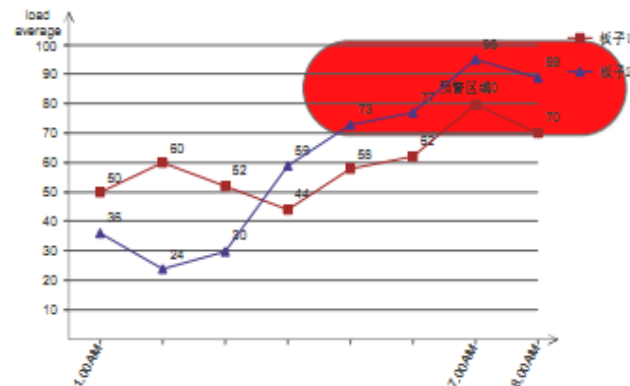
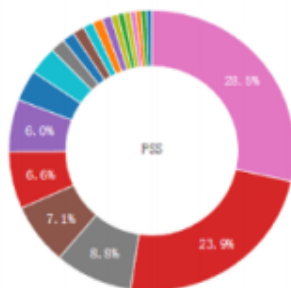
Familiar with Linux

# Save me



Not familiar with Linux

PID	USER	PR	NI
3005	baohua	20	0
1979	root	20	0
1771	root	0	-20
3425	baohua	20	0
3595	baohua	20	0
3045	baohua	20	0
1	root	20	0
2	root	20	0
3	root	20	0



A

All-in-one

B

Visualization

C

Interactive

D

Historical Record



E

Change/Trendency

F

Alarm/Dignose  
Expert Knowledge Base



# CPU Perspective

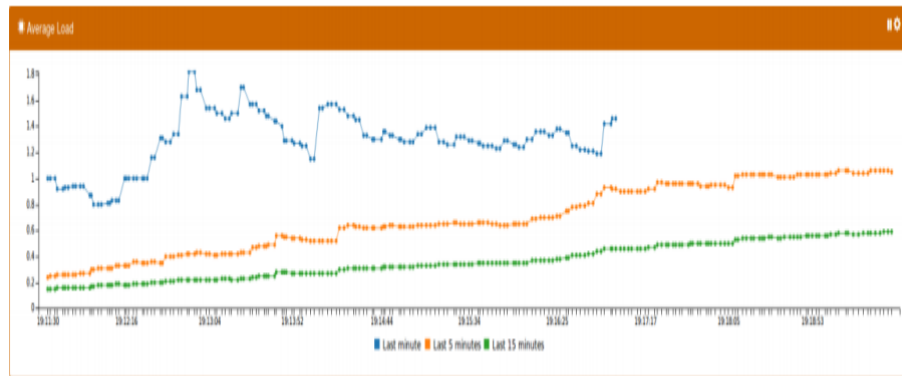
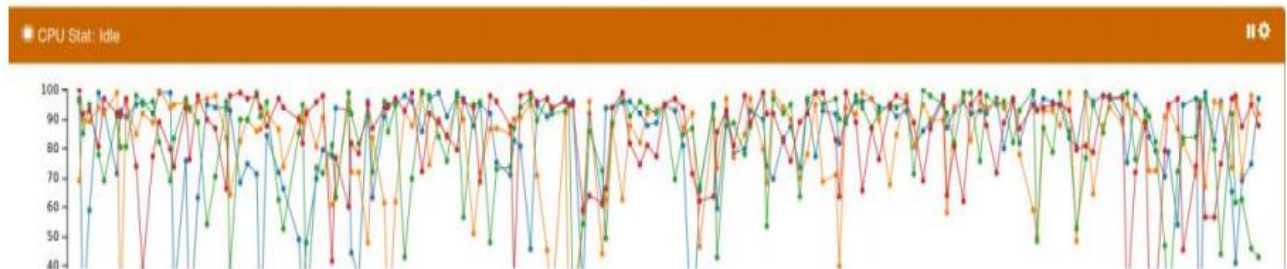
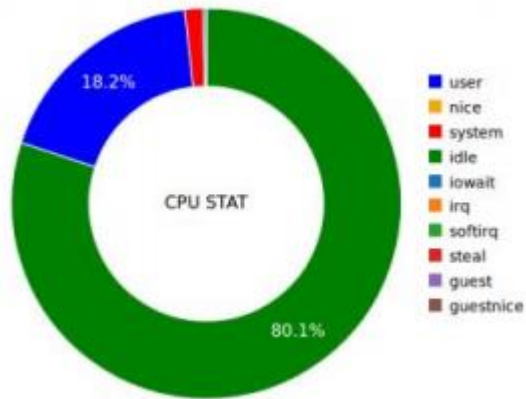
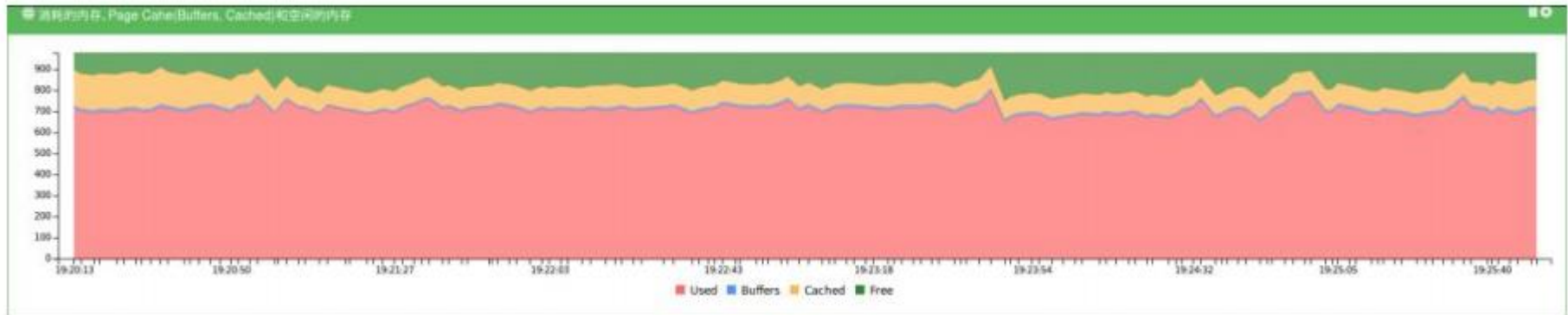


Table titled "CPU TOP" showing top CPU-consuming processes. The table includes columns for PID, USER, PRI, NI, VSZ, RSS, S, %CPU, %MEM, TIME, and CMD. The processes listed are kswapd0, /sbin/init, kthreadd, ksoftirqd0, kworker0/0H, and rcu\_sched.

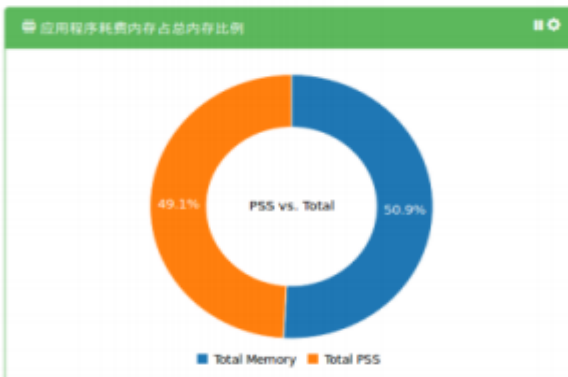
PID	USER	PRI	NI	VSZ	RSS	S	%CPU	%MEM	TIME	CMD
43	root	19	0	0	0	S	0.2	0.0	00:00:05	kswapd0
1	root	19	0	185772	2104	S	0.1	0.2	00:00:03	/sbin/init
2	root	19	0	0	0	S	0.0	0.0	00:00:00	kthreadd
3	root	19	0	0	0	S	0.0	0.0	00:00:00	ksoftirqd0
5	root	39	-20	0	0	S	0.0	0.0	00:00:00	kworker0/0H
7	root	19	0	0	0	S	0.0	0.0	00:00:01	rcu_sched

# MEM Perspective

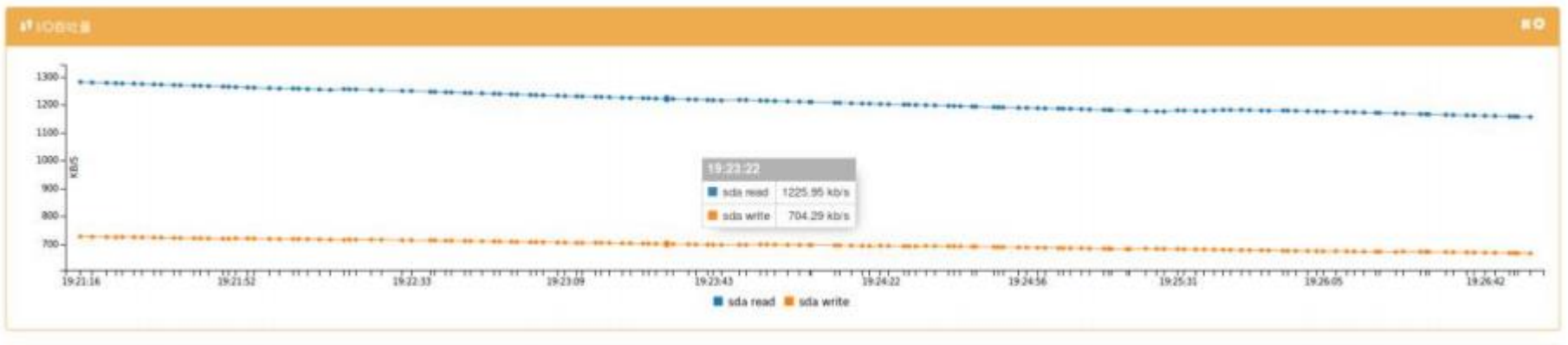


内存消耗 (单位: MB)

PID	VSS	RSS	PSS	USS	CMDLINE
14493	2638712	364712	351430	343036	/usr/lib/firefox/firefox
11766	403400	33808	24439	17060	/usr/lib/xorg/Xorg
13089	669044	17736	14340	14080	compiz
11720	655404	11264	9728	9712	/usr/bin/dockerd
13591	49088	7508	6468	6412	/lepd
14480	135760	9140	6914	6316	uwsgi
14482	135744	8872	6718	6144	uwsgi
14478	139948	8340	6201	5692	uwsgi



# IO Perspective



IO Top Table

Search:

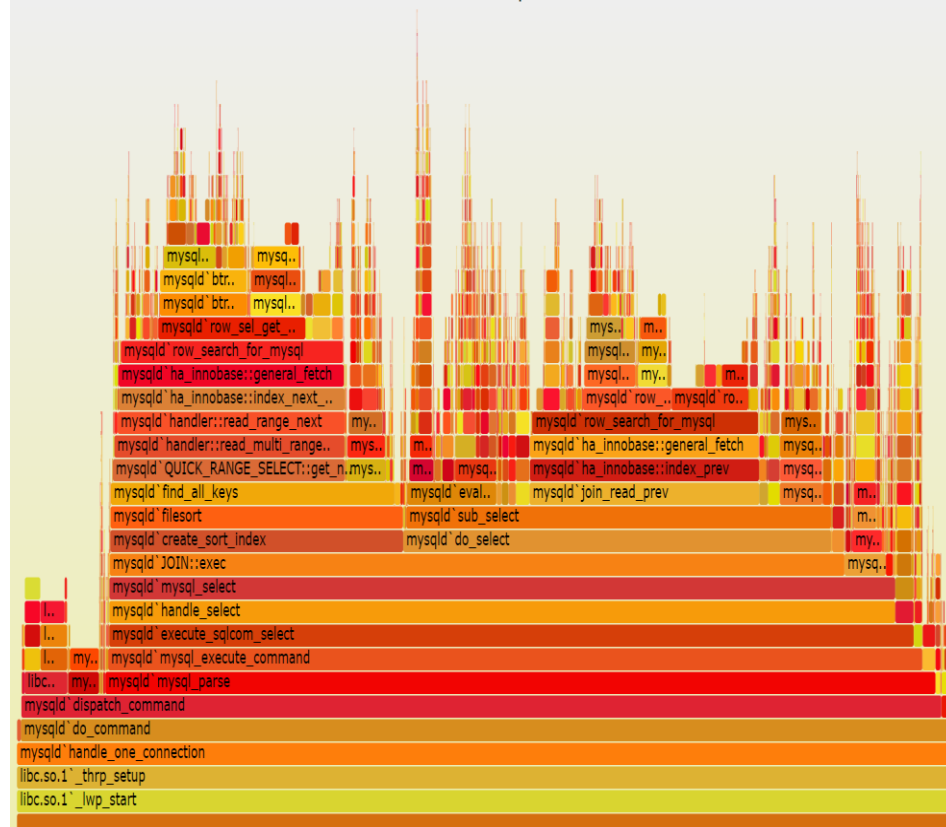
TID	PRIO	USER	DISK READ	DISK WRITE	SWAPIN	IO	COMMAND
1	be/4	root	0.00 B/s	0.00 B/s	0.00 %	0.00 %	/sbin/init auto noprompt
2	be/4	root	0.00 B/s	0.00 B/s	0.00 %	0.00 %	[kthread]
3	be/4	root	0.00 B/s	0.00 B/s	0.00 %	0.00 %	[ksotlrqd]
5	be/0	root	0.00 B/s	0.00 B/s	0.00 %	0.00 %	[kworker/0:0]
7	be/4	root	0.00 B/s	0.00 B/s	0.00 %	0.00 %	[rcu_sche]
8	be/4	root	0.00 B/s	0.00 B/s	0.00 %	0.00 %	[rcu_b]

# Perf Perspective

基于Symbol的时间分布 (perf top)

Command	Overhead	Shared Object	Symbol
malloc	53.53%	malloc	[.] main
swapper	32.87%	[kernel.kallsyms]	[k] native_safe_halt
malloc	12.50%	[kernel.kallsyms]	[k] clear_page
malloc	0.15%	[kernel.kallsyms]	[k] free_pages_prepare
malloc	0.13%	[kernel.kallsyms]	[k] get_page_from_freelist
malloc	0.10%	[kernel.kallsyms]	[k] _cond_resched
malloc	0.08%	[kernel.kallsyms]	[k] clear_huge_page
malloc	0.05%	[kernel.kallsyms]	[k] _do_page_fault
malloc	0.05%	[kernel.kallsyms]	[k] _raw_spin_lock
swapper	0.05%	[kernel.kallsyms]	[k] _do_softirq
malloc	0.03%	[kernel.kallsyms]	[k] page_add_new_anon_map
swapper	0.03%	[kernel.kallsyms]	[k] refresh_cpu_vm_stats
free	0.02%	[kernel.kallsyms]	[k] do_exit
free	0.02%	[kernel.kallsyms]	[k] page_add_file_map
free	0.02%	ld-2.19.so	[.] 0x0000000000009e2a
free	0.02%	libc-2.19.so	[.] 0x000000000007eae8
gpd	0.02%	[kernel.kallsyms]	[k] __fdget_raw
gpd	0.02%	[kernel.kallsyms]	[k] futex_wait
malloc	0.02%	[kernel.kallsyms]	[k] _do_softirq
malloc	0.02%	[kernel.kallsyms]	[k] lru_cache_add

Flame Graph



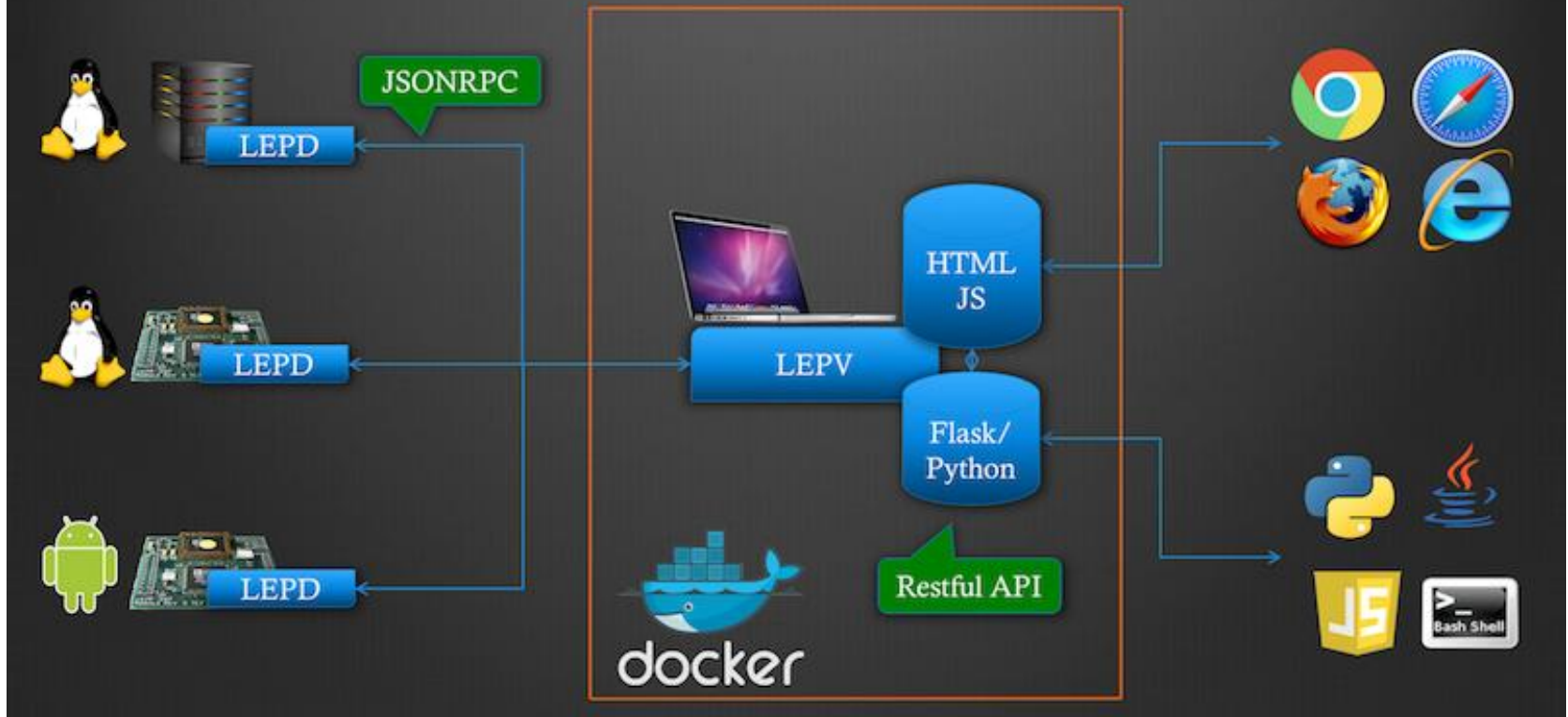
# Cgroup Perspective

- Demonstrate subsystem(cpu,mem,io,network)
- Demonstrate hierarchy
- Demonstrate their accounting

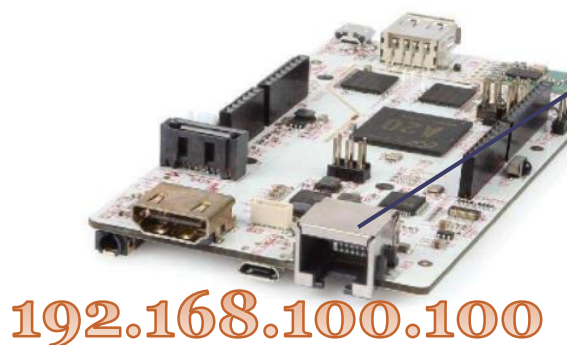
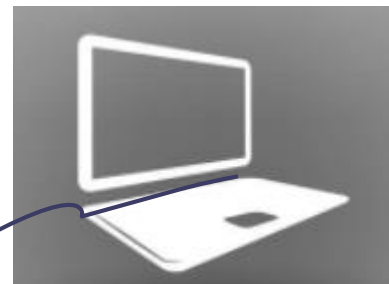
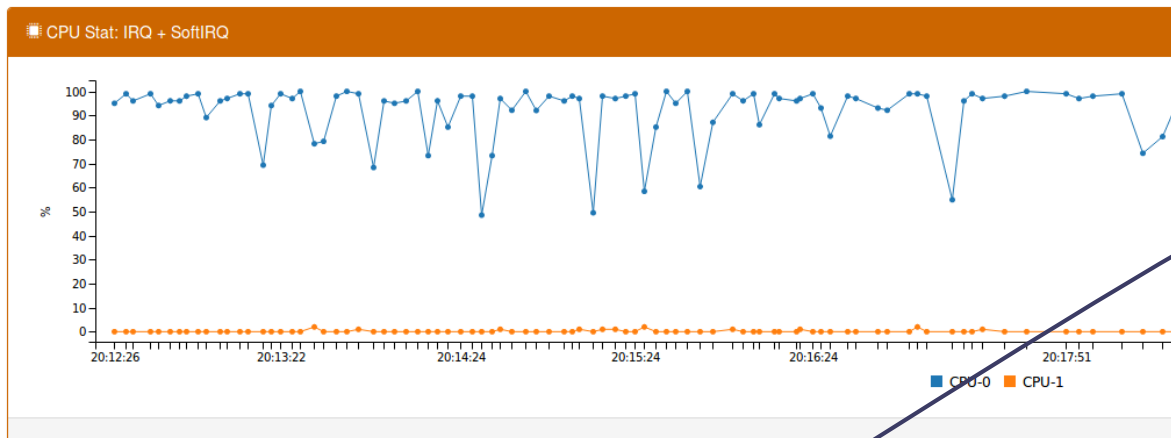
# LEP(Linux Easy Profiling)

Easy  
All-in-one  
Web-based

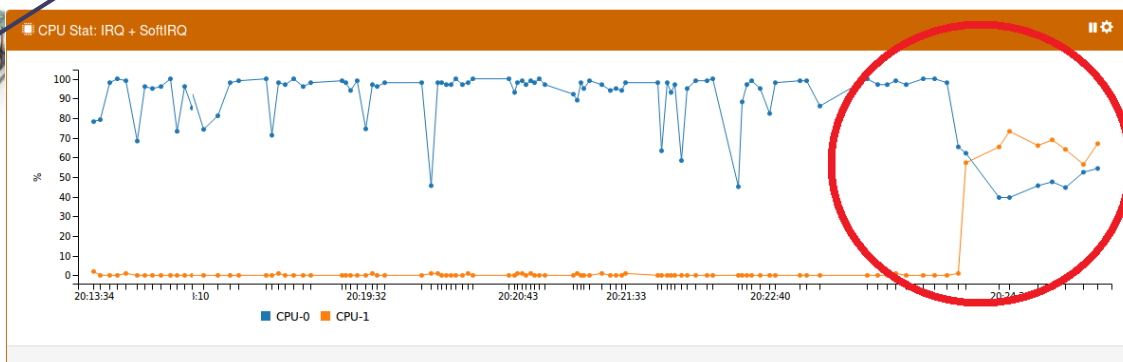
## LEP architecture



# demo: improve network throughput using LEP



192.168.100.100



Related Doc. 《LEP与负载均衡——以PCDUINO实际案例来使用LEP提高网络带宽》

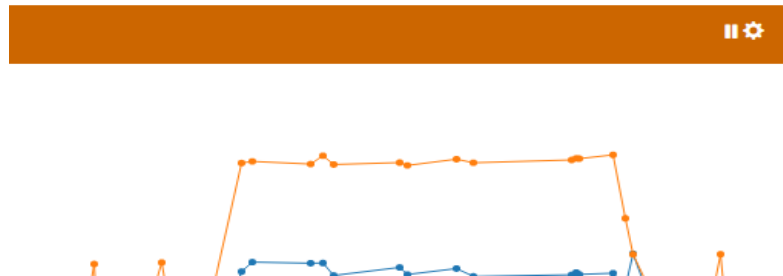
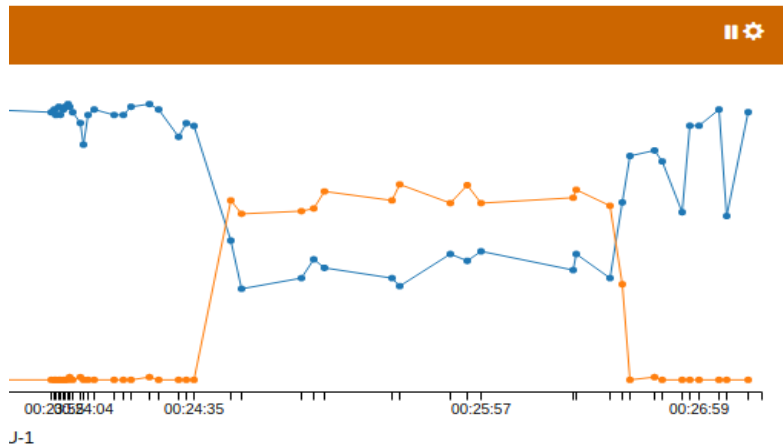
<http://mp.weixin.qq.com/s/FQKFRcMNDk6VE7ihnnvBPw>

# A snapshot of LEPV for the demo

127.0.0.1:8889 says:

Load NOT balanced! , Please check CPU Stat: Irq+SoftIrq  
chart

OK



Elements	Console	Sources	Network	Performance	Memory	6
top	Filter	Default levels	333 items hidden by filters			
Irq+SoftIrq: 45.63-68.93	~ Load Balanced snapshot	lepvCpuLineChart.js:127				
Irq+SoftIrq: 36.89-63.1	~ Load Balanced snapshot - 12 occurrences in a row	lepvCpuLineChart.js:166				
Irq+SoftIrq: 64.36-34.65	~ Load Balanced snapshot	lepvCpuLineChart.js:127				
Irq+SoftIrq: 81.19-0	~ Load Balanced snapshot - 14 occurrences in a row	lepvCpuLineChart.js:166				
Irq+SoftIrq: 83.17-0.99	- Load NOT Balanced snapshot, warning detected	lepvCpuLineChart.js:172				
- Load NOT Balanced snapshot - 2 occurrences in a row	lepvCpuLineChart.js:127					
Irq+SoftIrq: 79.21-0	- Load NOT Balanced snapshot, warning detected	lepvCpuLineChart.js:166				
Irq+SoftIrq: 60.78-0	- Load NOT Balanced snapshot - 3 occurrences in a row	lepvCpuLineChart.js:172				
Irq+SoftIrq: 92.16-0	- Load NOT Balanced snapshot, warning detected	lepvCpuLineChart.js:130				
- Load NOT Balanced snapshot - 4 occurrences in a row	lepvCpuLineChart.js:136					
Irq+SoftIrq: 98.02-0	- Load NOT Balanced snapshot, warning detected	lepvCpuLineChart.js:127				
Irq+SoftIrq: 59.41-0	- Load NOT Balanced snapshot - 5 occurrences in a row	lepvCpuLineChart.js:130				
Irq+SoftIrq: 97.06-0	- Load NOT Balanced snapshot, warning detected	lepvCpuLineChart.js:136				
Irq+SoftIrq: 96.04-0	- Load NOT Balanced snapshot - 6 occurrences in a row	lepvCpuLineChart.js:127				
	- Load NOT Balanced snapshot, warning detected	lepvCpuLineChart.js:130				
	- Load NOT Balanced snapshot - 7 occurrences in a row	lepvCpuLineChart.js:136				
	- Load NOT Balanced snapshot, warning detected	lepvCpuLineChart.js:127				
	- Load NOT Balanced snapshot - 8 occurrences in a row	lepvCpuLineChart.js:130				
	- Load NOT Balanced snapshot, warning detected	lepvCpuLineChart.js:136				
	- Load NOT Balanced snapshot - 9 occurrences in a row	lepvCpuLineChart.js:127				
	- Load NOT Balanced snapshot, warning detected	lepvCpuLineChart.js:130				
	- Load NOT Balanced snapshot - 10 occurrences in a row	lepvCpuLineChart.js:136				





Deeply data analysis and system status alert

Database

Scenerios-based profiling

Latency analysis(off-cpu io, scheduler runqueue, memory reclaim)

QA/Test



# More info

- Homepage: <http://www.linuxep.com/>
- Code : <https://github.com/linuxep>



**Thanks**