



Tuning System Performance



Unit objectives

After completing this unit, you should be able to:

- Understand performance optimization
- Manage and Select Tuning Profiles
- Influence Process Scheduling

Understand performance optimization

- Workload's requirement
- Adjusting settings based on requirement
- The tuned daemon
- Tuning profiles

Configuring Static Tuning

- When Service starts or
- Upon selection of new tuning profile
- Configures predefined kernel parameters
- Set for overall performance expectations
- Does not change over time

Configuring Dynamic Tuning

- The **tuned** daemon monitors system activity
- Adjust settings depending behavior change
- Continuously monitor and adjust tuning fit workload's requirement
- Example of behavior changes:
 - Storage device experience high usage during startup, but minimal user activities.
 - Network device experience high usage during peak hours throughout the days.
- The tuned daemon capture these activities and adjust parameters to
 - allocate more CPU resource to storage during startup and
 - re-allocate CPU to Network device during the days

Installing and enabling tuned

```
# yum install tuned
```

```
# systemctl enable --now tuned
```

```
# systemctl status tuned
```

Selecting a Tuning Profile 1/2

- with predefined settings
- Focus on
 - Low latency for storage and network
 - High throughput for storage and network
 - Virtual Machine performance
 - Virtualization host performance

Profiles distributed with RHEL v8

Tuned Profile	Purpose
balanced	Ideal for systems that require a compromise between power saving and performance.
desktop	Derived from the balanced profile. Provides faster response of interactive applications.
throughput - performance	Tunes the system for maximum throughput.
latency - performance	Ideal for server systems that require low latency at the expense of power consumption.
network - latency	Derived from the latency - performance profile. It enables additional network tuning parameters to provide low network latency.
network - throughput	Derived from the throughput - performance profile. Additional network tuning parameters are applied for maximum network throughput.
powersave	Tunes the system for maximum power saving.
oracle	Optimized for Oracle database loads based on the throughput - performance profile.
virtual-guest	Tunes the system for maximum performance if it runs on a virtual machine.
virtual-host	Tunes the system for maximum performance if it acts as a host for virtual machines.

Managing profiles from command line

- List all available profiles

tuned-adm list

- View current activated profile

tuned-adm active

- Switch profile

tuned-adm profile throughput-performance

- Ask for recommendation

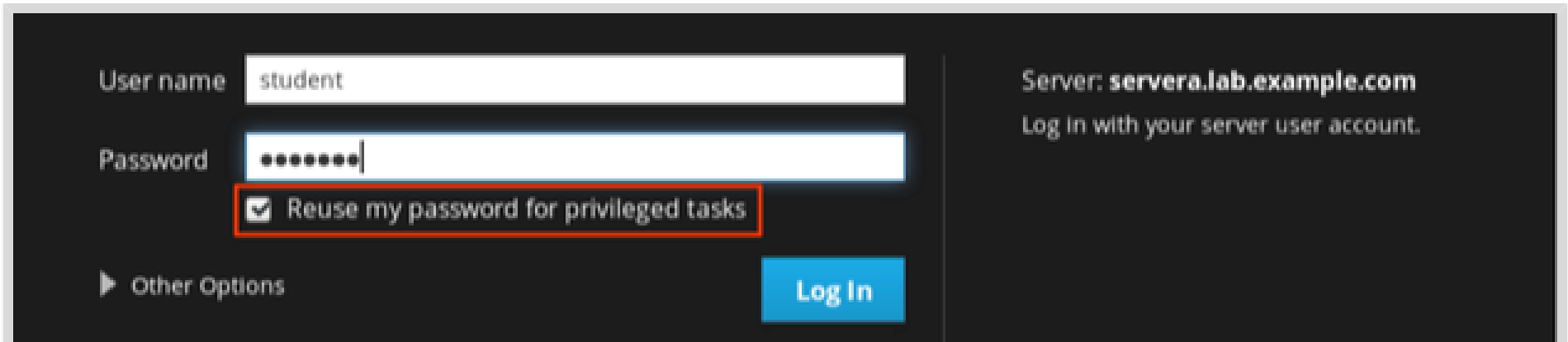
tuned-adm recommend

- Disable tuning activity

tuned-adm off

Managing profiles from Web Console

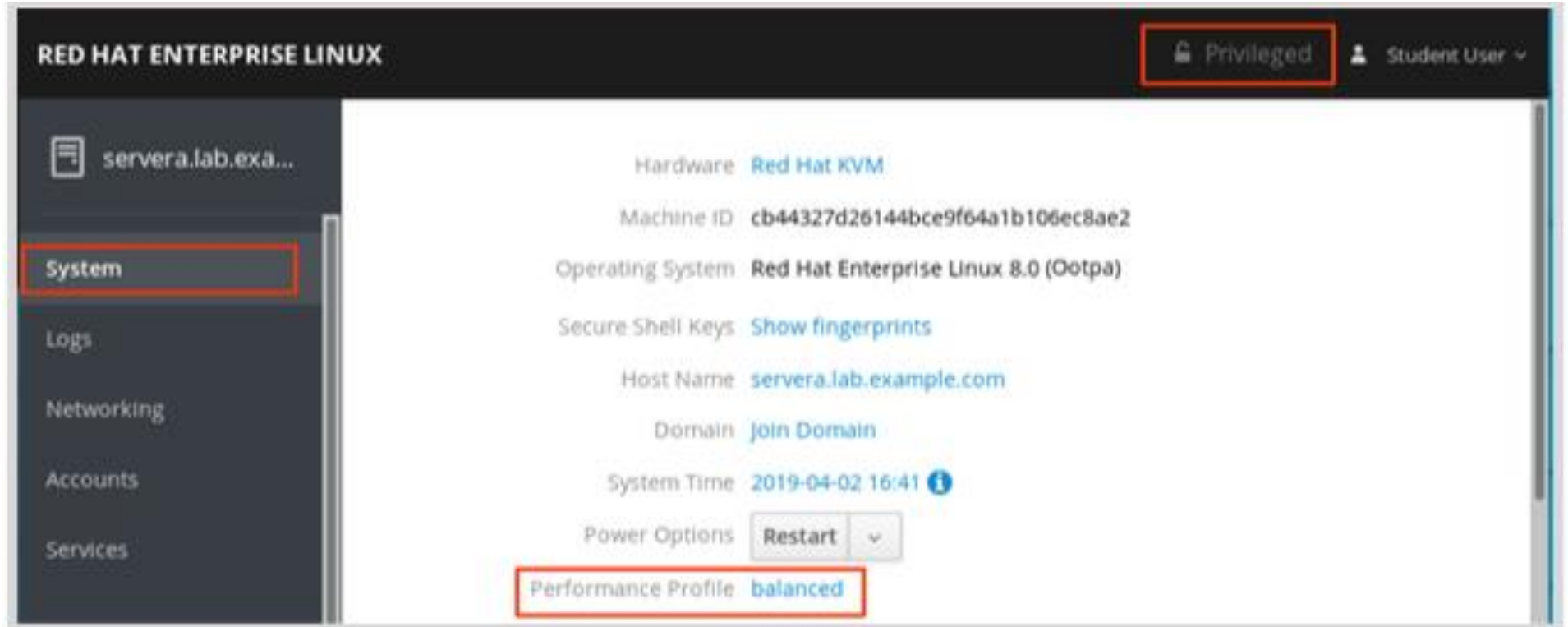
- For non-root, enable "Reuse my password for privileged tasks"



The image shows a web console login interface. On the left, there are input fields for 'User name' (containing 'student') and 'Password' (containing seven dots). Below the password field is a checkbox labeled 'Reuse my password for privileged tasks', which is checked and highlighted with a red border. To the left of the checkbox is a link 'Other Options' with a right-pointing triangle icon. To the right of the checkbox is a blue 'Log In' button. On the right side of the form, there is text indicating the server: 'Server: servera.lab.example.com' and a prompt: 'Log in with your server user account.'

Managing profiles from Web Console

- Click System > Enter Performance Profile



Managing profiles from Web Console v8.2

The screenshot displays the Red Hat Enterprise Linux Web Console v8.2 interface. The browser address bar shows the URL `https://servera:9090/system`. The page header includes the "RED HAT ENTERPRISE LINUX" logo, a "Privileged" status indicator, and a user profile for "Student User".

The left sidebar contains a navigation menu with the following items: Overview (selected), Logs, Networking, Podman Containers, Virtual Machines, Accounts, Services, Applications, and Diagnostic Reports.

The main content area is divided into several sections:

- Health:** Displays two status messages: "Loading available updates failed" (with a red exclamation mark icon) and "Not connected to Insights" (with a yellow warning triangle icon).
- Usage:** Shows resource utilization with progress bars and text: CPU at "1% of 2 CPUs" and Memory at "0.8 / 1.8 GiB". A link "View graphs" is provided below.
- System information:** A table listing system details:

Model	Red Hat OpenStack Compute
Asset tag	00000000-0000-0000-0000-ac1f6bc5380a
Machine ID	f874df04639f474cb0a9881041f4f7d4

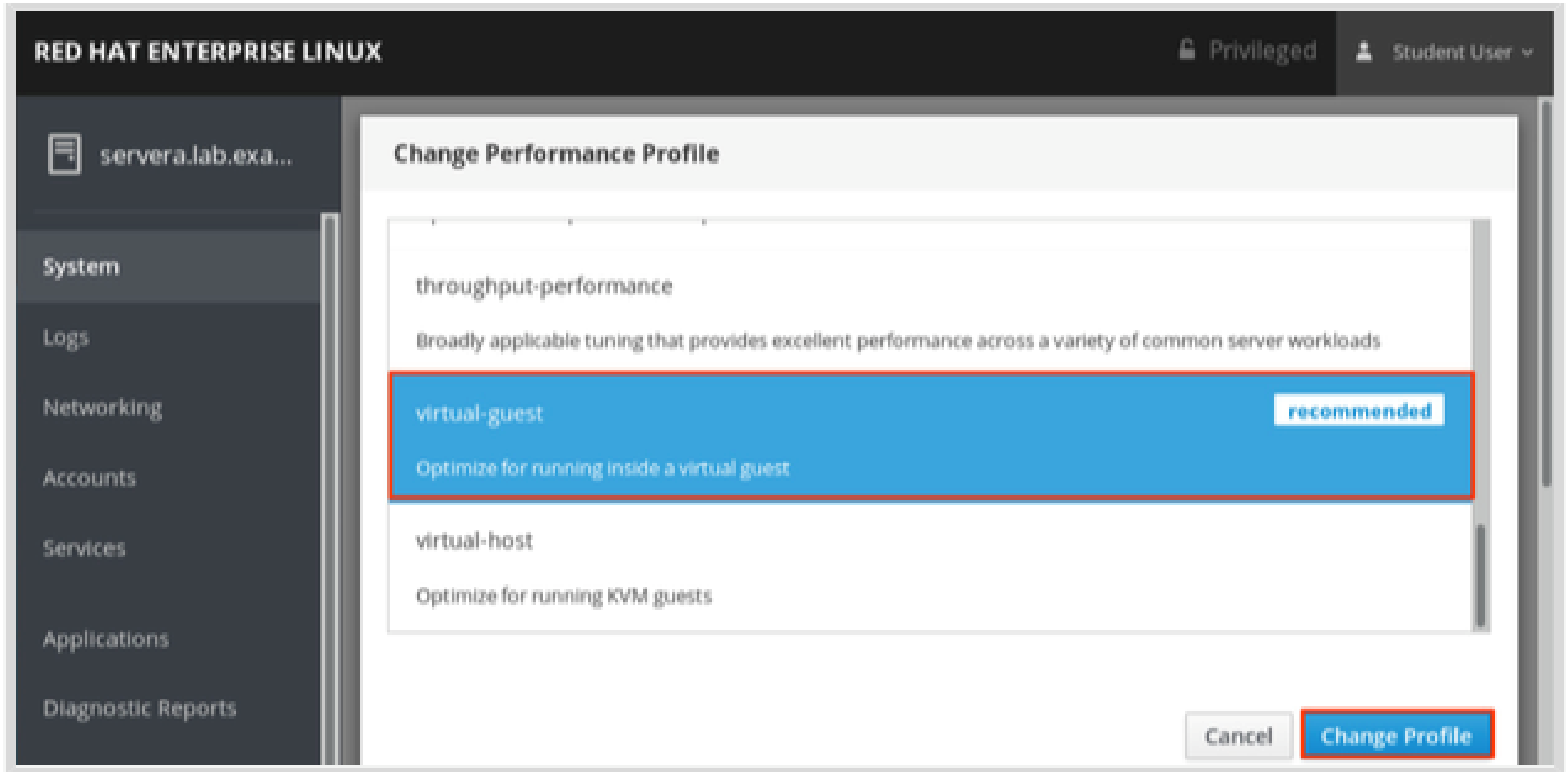
A link "View hardware details" is located at the bottom of this section.
- Configuration:** A table listing configuration details:

Hostname	servera.lab.example.com edit
System time	2020-10-04 19:49
Domain	Join Domain
Performance profile	network-latency
Secure Shell keys	Show fingerprints

The "Performance profile" row is highlighted with a red rectangular border.

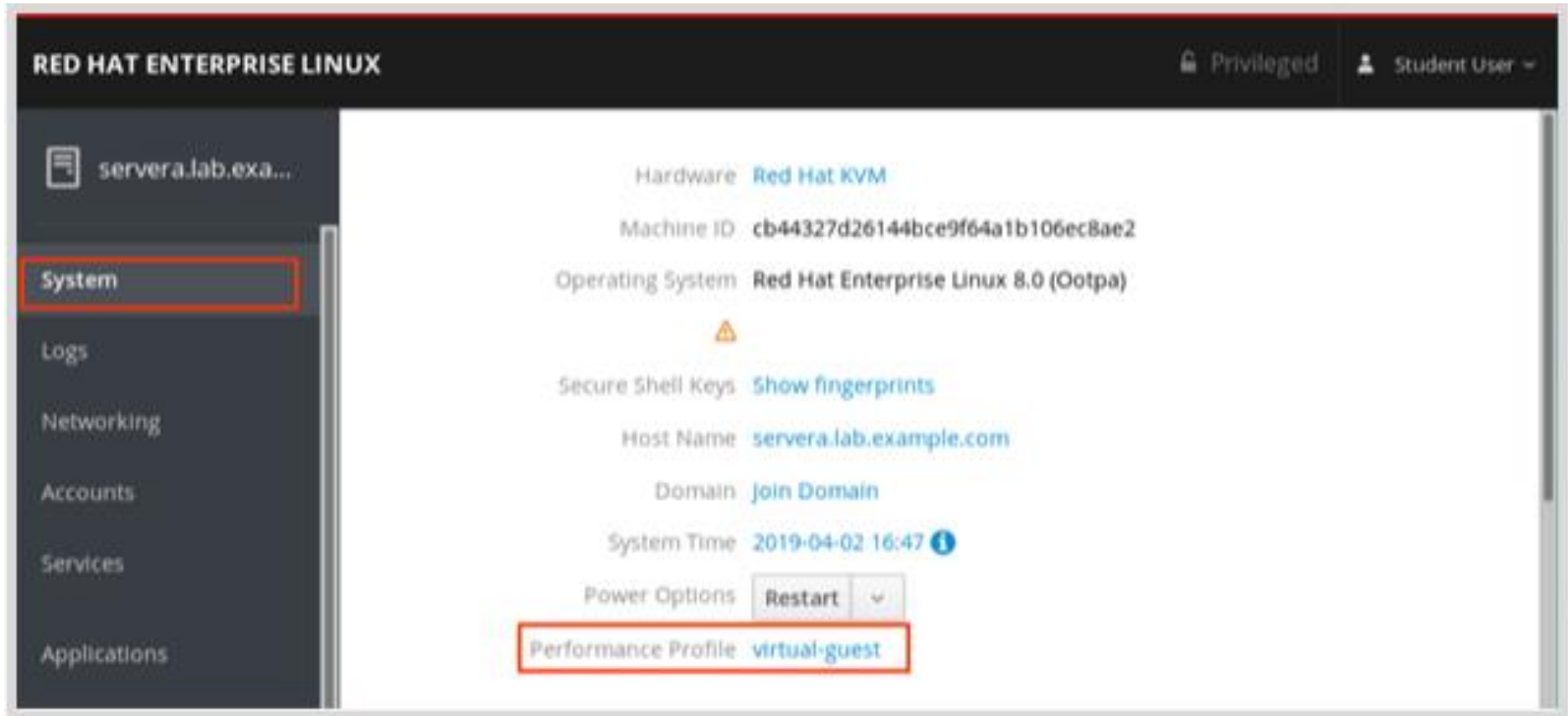
Managing profiles from Web Console

- Select a profile > Click Change Profile



Managing profiles from Web Console

- Verify changes



Influencing Process Scheduling

- Understand Linux Process Scheduling and Multitasking
- Relative Priorities
- Setting Nice Levels and Permissions

Understand Linux Process Scheduling and Multitasking

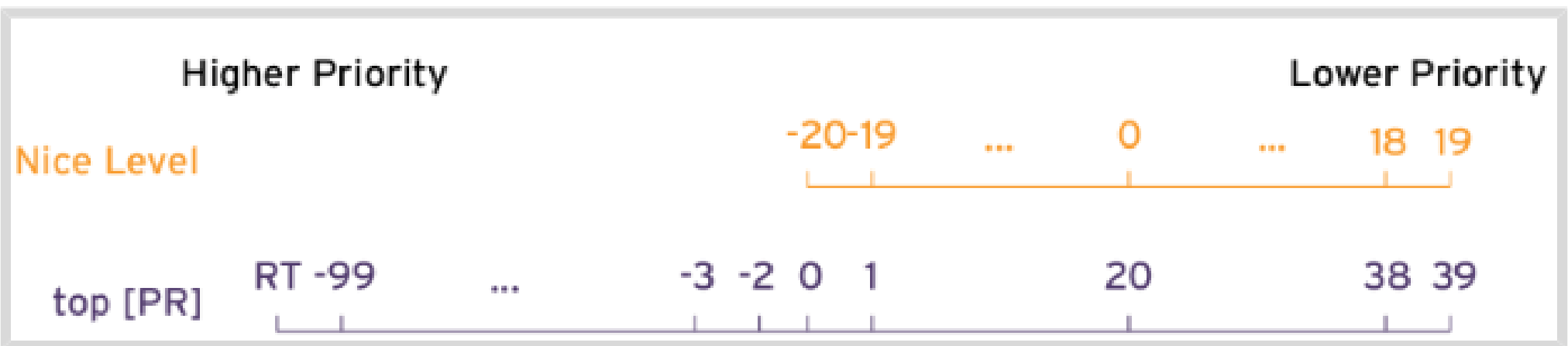
- Low end to High end Systems
- Single to Multiple CPUs
- CPU to execute instructions
 - dozens to millions
 - parallel
- Common traits: Requirement to run more process threads than CPU
- Linuxs uses time-slicing or multitasking
- Process Scheduler
 - switch processes in/out single core
 - Multiple processes running simultaneously
 - Has multiple scheduling policies for different processes

Relative Priorities

- Each process given level of importance
- Process Scheduler
 - Policy : `SCHED_FIFO`, `SCHED_RR` and `SCHED_OTHER`
 - default to `SCHED_OTHER`
- Use PR and NICE to determine importance
- NICE range -20 (highest) to 19 (lowest)
- NICE value 19, often don't get CPU time when system is busy
- Default NICE 0
- Child process inherit nice from parent
- No contention for CPU, higher NICE process may use all CPU

Nice Levels and Permissions

- Settings NICE
 - Only root can adjust process NICE level
 - Non-root users permitted to increase process NICE level of their own processes
- Reporting Nice Levels
 - PR : Scheduled priority : Set by Kernel
 - NI : NICE level : Set by user



Displaying NICE levels using TOP command

- Result in real time

```
top - 08:10:36 up 5:28, 2 users, load average: 0.38, 0.29, 0.24
Tasks: 300 total, 7 running, 293 sleeping, 0 stopped, 0 zombie
%Cpu(s): 0.1 us, 1.8 sy, 0.0 ni, 95.6 id, 0.0 wa, 2.4 hi, 0.2 si, 0.0 st
MiB Mem : 1800.6 total, 157.4 free, 1295.2 used, 348.1 buff/cache
MiB Swap: 2048.0 total, 2029.0 free, 19.0 used. 319.5 avail Mem
```

PID	USER	PR	NI	VIRT	RES	SHR	S	%CPU	%MEM	TIME+	COMMAND
7072	root	20	0	0	0	0	S	2.3	0.0	4:51.49	kvdo0:indexW
7073	root	20	0	0	0	0	S	1.3	0.0	4:31.10	kvdo0:indexW
5805	root	20	0	0	0	0	R	1.0	0.0	2:54.92	callbackW
5999	root	20	0	0	0	0	S	1.0	0.0	3:02.67	kvdo1:indexW
6000	root	20	0	0	0	0	S	1.0	0.0	4:44.57	kvdo1:indexW
5991	root	20	0	0	0	0	S	0.3	0.0	0:24.35	kvdo1:cpuQ1
1	root	20	0	246028	12080	7048	S	0.0	0.7	0:06.26	systemd
2	root	20	0	0	0	0	S	0.0	0.0	0:00.05	kthreadd
3	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	rcu_gp
4	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	rcu_par_gp
6	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	kworker/0:0H
8	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	mm_percpu_wq
9	root	20	0	0	0	0	S	0.0	0.0	0:01.10	ksoftirqd/0
10	root	20	0	0	0	0	R	0.0	0.0	0:00.87	rcu_sched
11	root	rt	0	0	0	0	S	0.0	0.0	0:00.00	migration/0
12	root	rt	0	0	0	0	S	0.0	0.0	0:00.00	watchdog/0
13	root	20	0	0	0	0	S	0.0	0.0	0:00.00	cpuhp/0
14	root	20	0	0	0	0	S	0.0	0.0	0:00.00	cpuhp/1
15	root	rt	0	0	0	0	S	0.0	0.0	0:00.00	watchdog/1
16	root	rt	0	0	0	0	S	0.0	0.0	0:00.00	migration/1
17	root	20	0	0	0	0	S	0.0	0.0	0:00.37	ksoftirqd/1
18	root	0	-20	0	0	0	T	0.0	0.0	0:00.00	kworker/1:0H-kblockd

Displaying NICE levels using PS command

- Show unsorted process with extra information

```
# ps axo pid,comm,nice,cls
```

- Show process with extra information and sort by NICE ascendingly

```
# ps axo pid,comm,nice,cls --sort=nice
```

- Show process with extra information and sort by NICE descendingly

```
# ps axo pid,comm,nice,cls --sort=-nice
```

PID	COMMAND	NI	CLS
1	systemd	0	TS
2	kthreadd	0	TS
3	rcu_gp	-20	TS
4	rcu_par_gp	-20	TS
6	kworker/0:0H	-20	TS
8	mm_percpu_wq	-20	TS
9	ksoftirqd/0	0	TS
10	rcu_sched	0	TS
11	migration/0	-	FF
12	watchdog/0	-	FF
13	cpuhp/0	0	TS
14	cpuhp/1	0	TS
15	watchdog/1	-	FF
16	migration/1	-	FF
17	ksoftirqd/1	0	TS
19	kworker/1:0H-kb	-20	TS
20	cpuhp/2	0	TS
21	watchdog/2	-	FF
22	migration/2	-	FF
23	ksoftirqd/2	0	TS
25	kworker/2:0H-kb	-20	TS
26	cpuhp/3	0	TS
27	watchdog/3	-	FF
28	migration/3	-	FF
29	ksoftirqd/3	0	TS

Displaying NICE levels using HTOP command

```

1  [|||||] 4.8%] Tasks: 59, 65 thr; 4 running
2  [|||||] 4.8%] Load average: 0.11 0.28 0.28
3  [|||||] 5.4%] Uptime: 05:56:04
4  [|||||] 4.0%]
Mem[|||||] 1.27G/1.76G]
Swp[|] 28.8M/2.00G]

```

PID	USER	PRI	NI	VIRT	RES	SHR	S	CPU%	MEM%	TIME+	Command
14384	root	20	0	1153M	17516	13004	S	0.0	0.9	0:00.00	/usr/libexec/udisks2/udisksd
14280	root	20	0	1153M	17516	13004	S	0.0	0.9	0:00.00	/usr/libexec/udisks2/udisksd
14267	root	20	0	1153M	17516	13004	S	0.0	0.9	0:00.00	/usr/libexec/udisks2/udisksd
14265	root	20	0	1153M	17516	13004	S	0.0	0.9	0:00.00	/usr/libexec/udisks2/udisksd
6845	root	20	0	459M	1640	840	S	0.0	0.1	0:04.53	/usr/bin/vmhgfs-fuse .host:/ /mnt/hgfs -o subtype=
6897	root	20	0	459M	1640	840	S	0.0	0.1	0:00.82	/usr/bin/vmhgfs-fuse .host:/ /mnt/hgfs -o subtype=
6896	root	20	0	459M	1640	840	S	0.0	0.1	0:00.87	/usr/bin/vmhgfs-fuse .host:/ /mnt/hgfs -o subtype=
6895	root	20	0	459M	1640	840	S	0.0	0.1	0:00.89	/usr/bin/vmhgfs-fuse .host:/ /mnt/hgfs -o subtype=
6852	root	20	0	459M	1640	840	S	0.0	0.1	0:00.00	/usr/bin/vmhgfs-fuse .host:/ /mnt/hgfs -o subtype=
6850	root	20	0	459M	1640	840	S	0.0	0.1	0:00.98	/usr/bin/vmhgfs-fuse .host:/ /mnt/hgfs -o subtype=
6849	root	20	0	459M	1640	840	S	0.0	0.1	0:00.92	/usr/bin/vmhgfs-fuse .host:/ /mnt/hgfs -o subtype=
5840	root	20	0	195M	28116	12188	S	0.0	1.5	0:01.92	/usr/sbin/dmeventd -f
5998	root	20	0	195M	28116	12188	S	0.0	1.5	0:00.16	/usr/sbin/dmeventd -f
5842	root	20	0	195M	28116	12188	S	0.0	1.5	0:01.03	/usr/sbin/dmeventd -f
2334	root	20	0	186M	10988	9420	S	0.0	0.6	0:00.07	login -- root
12365	root	20	0	26692	4820	2820	S	0.0	0.3	0:00.04	-bash
1970	dnsmasq	20	0	71888	1448	1012	S	0.0	0.1	0:00.02	/usr/sbin/dnsmasq --conf-file=/var/lib/libvirt/dnsm
1971	root	20	0	71860	428	0	S	0.0	0.0	0:00.00	/usr/sbin/dnsmasq --conf-file=/var/lib/libvirt/dnsm
1662	rtdkit	20	0	195M	3316	2980	S	0.0	0.2	0:00.10	/usr/libexec/rtdkit-daemon
1491	user	20	0	93988	5924	4292	S	0.0	0.3	0:00.28	/usr/lib/systemd/systemd --user
1872	user	20	0	82592	4116	3628	S	0.0	0.2	0:00.01	/usr/bin/dbus-daemon --session --address=systemd: -
1883	user	20	0	82592	4116	3628	S	0.0	0.2	0:00.00	/usr/bin/dbus-daemon --session --address=systemd: -
1612	user	20	0	293M	6144	4960	S	0.0	0.3	0:00.08	/usr/bin/pulseaudio --daemonize=no
1871	user	20	0	293M	6144	4960	S	0.0	0.3	0:00.00	/usr/bin/pulseaudio --daemonize=no
1537	user	20	0	167M	3904	0	S	0.0	0.2	0:00.00	(sd-pam)
1490	root	20	0	93968	5944	4328	S	0.0	0.3	0:00.26	/usr/lib/systemd/systemd --user
1665	root	20	0	82592	4328	3844	S	0.0	0.2	0:00.02	/usr/bin/dbus-daemon --session --address=systemd: -
1699	root	20	0	82592	4328	3844	S	0.0	0.2	0:00.00	/usr/bin/dbus-daemon --session --address=systemd: -
1540	root	20	0	155M	4068	0	S	0.0	0.2	0:00.00	(sd-pam)
1480	root	20	0	42624	1996	1792	S	0.0	0.1	0:00.01	/usr/sbin/atd -f
1478	root	20	0	27876	3060	2200	S	0.0	0.2	0:00.20	/usr/sbin/crond -n
1474	root	20	0	204M	6488	4388	S	0.0	0.4	0:00.94	/usr/sbin/rsyslogd -n
1487	root	20	0	204M	6488	4388	S	0.0	0.4	0:00.02	/usr/sbin/rsyslogd -n
1483	root	20	0	204M	6488	4388	S	0.0	0.4	0:00.88	/usr/sbin/rsyslogd -n

1Help F2Setup F3Search F4Filter F5Tree F6SortBy F7Nice -F8Nice +F9Kill F10Quit

Set NICE Levels – starting new process

- Default, child process start inherit from parent
- Process start from command line, inherit from shell
- Typically new processes runs with NICE value 0
- Example: Start a process with default NICE

```
[user@host ~]$ sha1sum /dev/zero &  
[1] 3480  
[user@host ~]$ ps -o pid,comm,nice 3480  
  PID COMMAND      NI  
 3480 sha1sum        0
```

- Example: Start a process with NICE value = 10

```
[user@host ~]$ nice sha1sum /dev/zero &  
[1] 3517  
[user@host ~]$ ps -o pid,comm,nice 3517  
  PID COMMAND      NI  
 3517 sha1sum       10
```

Set NICE Levels – starting new process

- Example: Start a process with custom NICE

```
[user@host ~]$ nice -n 15 sha1sum &  
[1] 3521  
[user@host ~]$ ps -o pid,comm,nice 3521  
  PID COMMAND      NI  
 3521 sha1sum      15
```

- Important:

Unprivileged users may only increase NICE value from current to maximum of 19.

Root may reduce it to -20

Set NICE Levels – on existing process

- Example: Change process ID 3521 NICE value to 19

```
[user@host ~]$ renice -n 19 3521  
3521 (process ID) old priority 15, new priority 19
```

- Example: Using htop (F7 & F8)
- Important:
Unprivileged users may only increase NICE value from current to maximum of 19.
Root may reduce it to -20

Guided Exercise

Topic	Page number on student-guide.pdf	Time (min)
Killing Processes	186	10
Monitoring Process Activity	195	10
Adjusting Tuning Profiles	205	10
Influencing Process Scheduling	211	10



Quiz

1. Change existing process id 1234 NICE to -15.
 - a) `chprio -pri -5 1234`
 - b) `chprio 1234 -prio -5`
 - c) `kill -15 1234`
 - d) `renice -n -15 1234`

2. Which are possible commands to see NICE value? [Choose all applies]
 - a) `ps aux`
 - b) `ps axo pid,comm,ni`
 - c) `top`
 - d) `ps -ef`

3. User james attempted to change his own process NICE value # `renice -5 25999` but got error saying permission denied. What is the possible reason?
 - a) Underprivileged user are not permitted to use `renice` command
 - b) Underprivileged user can only increase NICE value but never decrease it
 - c) User james did not have appropriate ACL permission to the file
 - d) User james did not have appropriate permission to the process

Quiz - Answer

1. Change existing process id 1234 NICE to -15.
 - a) `chprio -pri -5 1234`
 - b) `chprio 1234 -prio -5`
 - c) `kill -15 1234`
 - d) `renice -n -15 1234`

2. Which are possible commands to see NICE value? [Choose all applies]
 - a) `ps aux`
 - b) `pa axo pid,comm,ni`
 - c) `top`
 - d) `ps -ef`

3. User james attempted to change his own process NICE value # `renice -5 25999` but got error saying permission denied. What is the possible reason?
 - a) Underprivileged user are not permitted to use `renice` command
 - b) Underprivileged user can only increase NICE value but never decrease it
 - c) User james did not have appropriate ACL permission to the file
 - d) User james did not have appropriate permission to the process

Quiz

4. Devops team install and configure a database system . It was running fine until next reboot, the database system misbehave. You suspect this is due to dynamic tuning by the kernel. How do you stop the dynamic tuning?
- a) `tuned --stop`
 - b) `tuned --disable`
 - c) `systemctl stop tuned`
 - d) `tuned-adm off`
5. True or False: Higher NICE value has more priority

Quiz - Answer

4. Devops team install and configure a database system . It was running fine until next reboot, the database system misbehave. You suspect this is due to dynamic tuning by the kernel. How do you stop the dynamic tuning?
- a) `tuned --stop`
 - b) `tuned --disable`
 - c) `systemctl stop tuned`
 - d) `tuned-adm off`
5. True or **False**: Higher NICE value has more priority

Unit summary

Having completed this unit, you should be able to:

- Understand performance optimization
- Manage and Select Tuning Profiles
- Influence Process Scheduling