OFFLINE SCHEDULER BOF

Raz Ben Yehuda
Linux plumbers conference 2009

CONCEPT

PARTIAL PARTITIONING vs PURE PARTITIONING

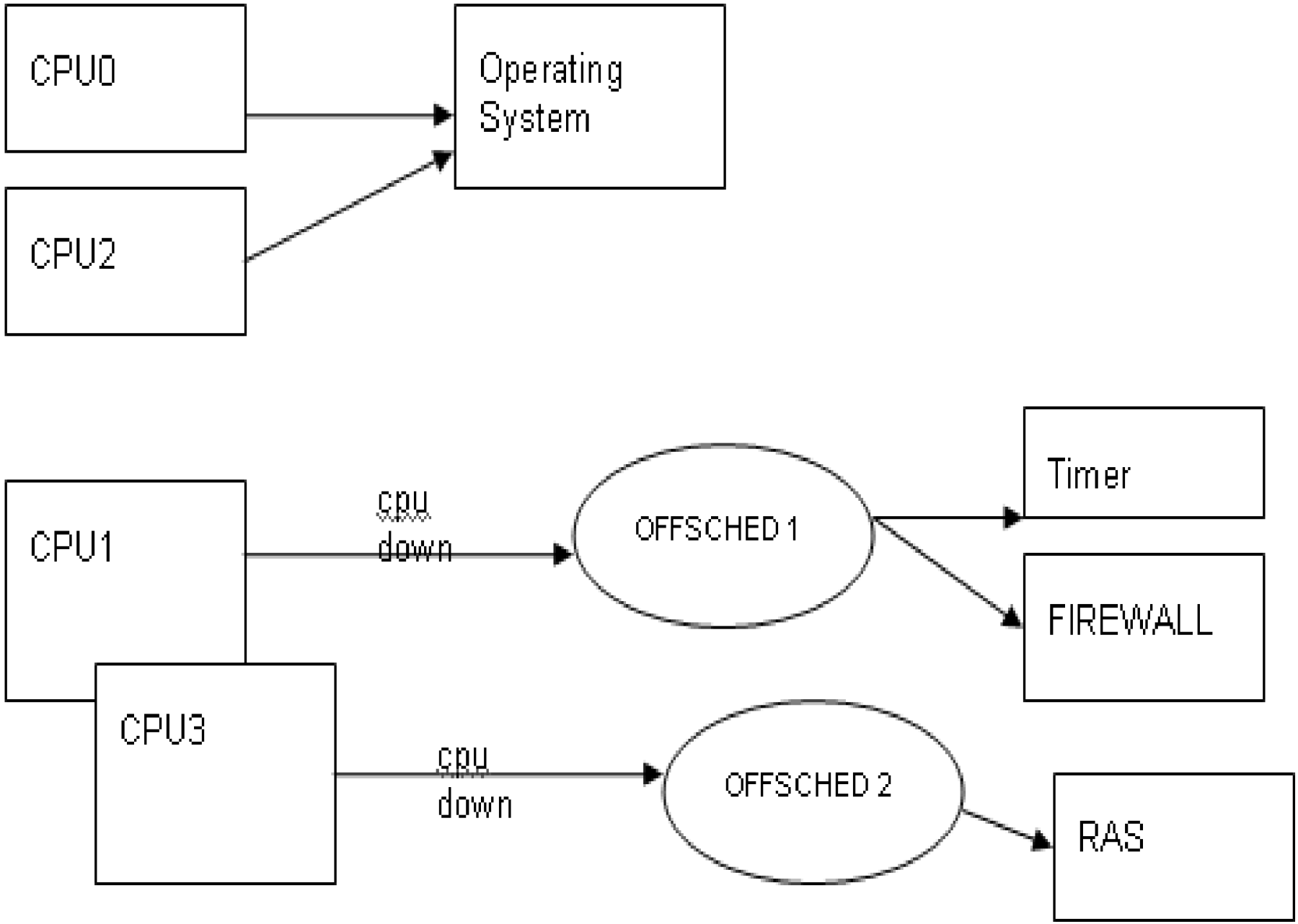
PROCESSOR is a DEVICE vs PROCESSOR is the SYSTEM

CONS

1. CANNOT RUN USER SPACE TASKS
2. RELEATIVELY HARD TO DEVELOP
3. ONLY FOR SMP/SMT/MC SYSTEMS
4. INDIRECT ACCESS TO VMALLOC AREA
5. NO CONTEXT SWITCH
6. DOES NOT PRESERVE STATES
7. NOT MAINLINE

PROS

1. PERFORMANCE
2. CONTAINMENT
3. ACCURACY
4. SPEED-UP
5. CONSISTENCY
6. HYBRID SYSTEM
7. ASYMMETRIC PROCESSING
8. INDEPENDENT SYSTEMS
9. BINDING PERIPHERIAL TO AN OFFLINE PROCESSOR
   (SMART IO DEVICE)


CPU0
CPU2
Operating System
CPU1
CPU3
cpu down
cpu down
OFFSCHED 1
OFFSCHED 2
Timer
FIREWALL
RAS

OFFLINE REAL TIME

NMI
- undisturbed (interrupt-less)
- accurate

PROGRAM SIZE
- best at many small programs

ISOLATION
- easier to analyze

SERIALIZATION
- Full preemption control

SPEED-UP
- linear – nearly up to BUS contention

CPU QUIESCE
- No need to walk through a quiesce state

PATCH OVERHEAD
- Can be used with any Linux kernel that supports processor un-plugging

OFFLINE REAL TIME - OFFLETS

OFFLET is a context running NMI outside the operating system
OFFLET can be scheduled to a target processor and in a specific point in time.

```
...
int cpu_idx=3;
offlet x;
....

offsched_schedule(&x,11,cpu_idx,my_arg);
```

schedule an offlet to run on processor 3 in 11 time units from now.

The Minimum Patch

```
 #ifdef CONFIG_HOTPLUG_CPU
+void (*hotplug_cpu_dead)(void);
+EXPORT_SYMBOL(hotplug_cpu_dead);
 DECLARE_PER_CPU(int, cpu_state);

 #include <asm/nmi.h>
__get_cpu_var(cpu_state) = CPU_DEAD;

local_irq_disable();
+if (hotplug_cpu_dead)
+hotplug_cpu_dead();
 while (1)
        halt();
 }
@@ -1265,8 +1265,6 @@
/* They ack this in play_dead by
 setting CPU_DEAD */
if (per_cpu(cpu_state, cpu) == CPU_DEAD) {
-       if (1 == num_online_cpus())
-               alternatives_smp_switch(0);
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        }
        msleep(100);
```
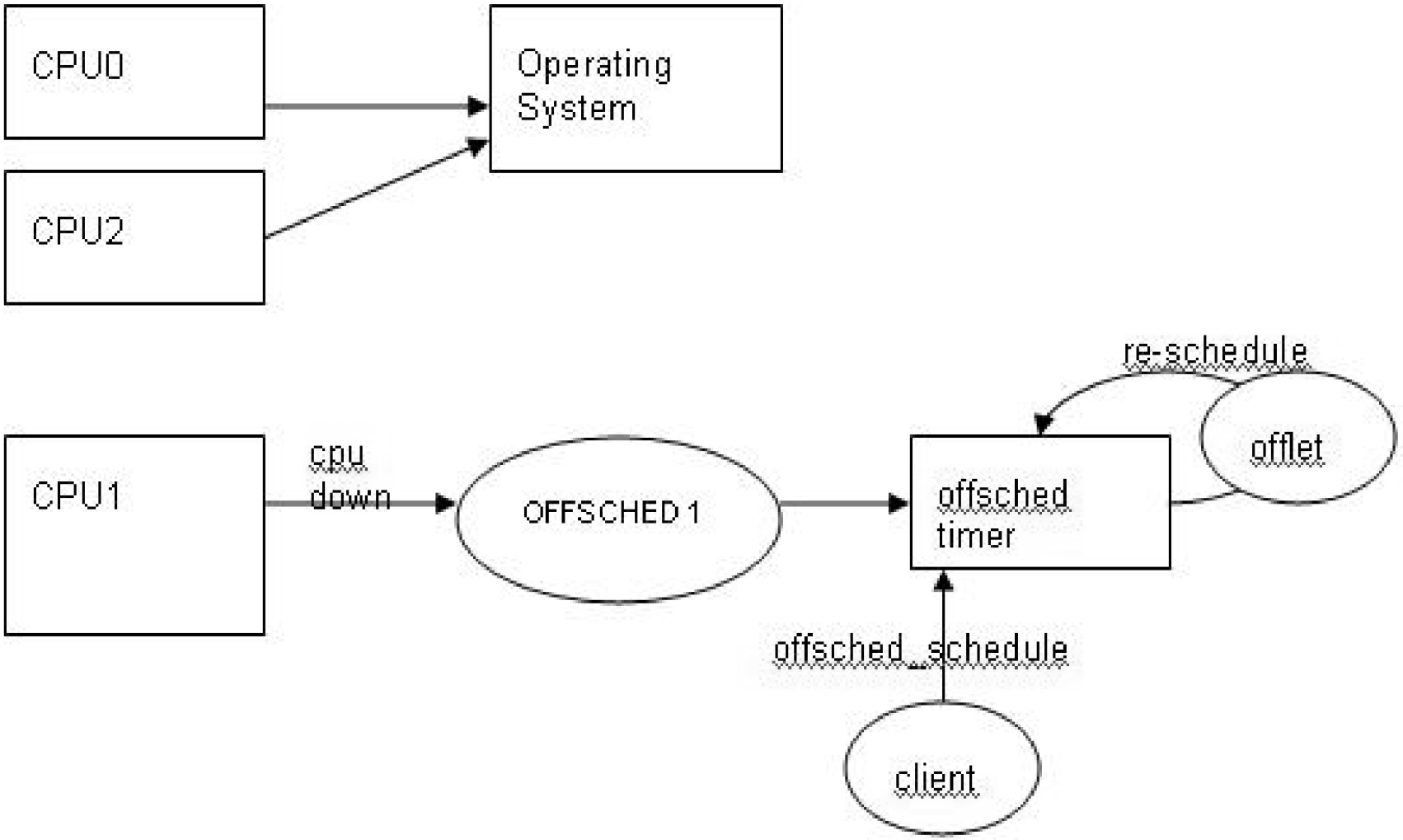

This patch does not include the memory allocation/de-allocation and offline napi.

Real Time example - 1us timer



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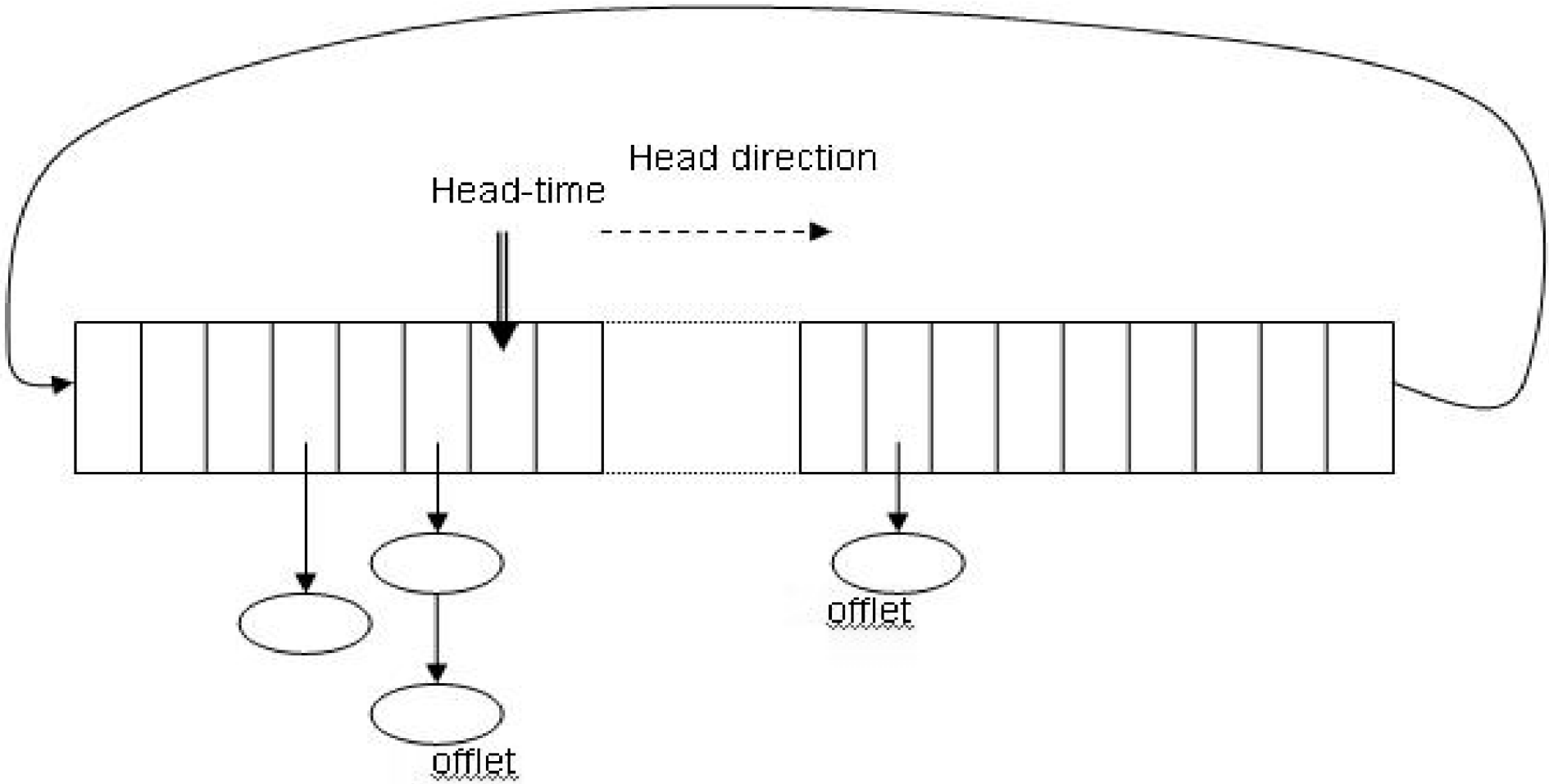


Real Time example - 1us timer pros and cons

cons
1. no need in low resolution timers
2. use TICKLESS if can.
3. if the transition from the offlet to the application is too complicated.

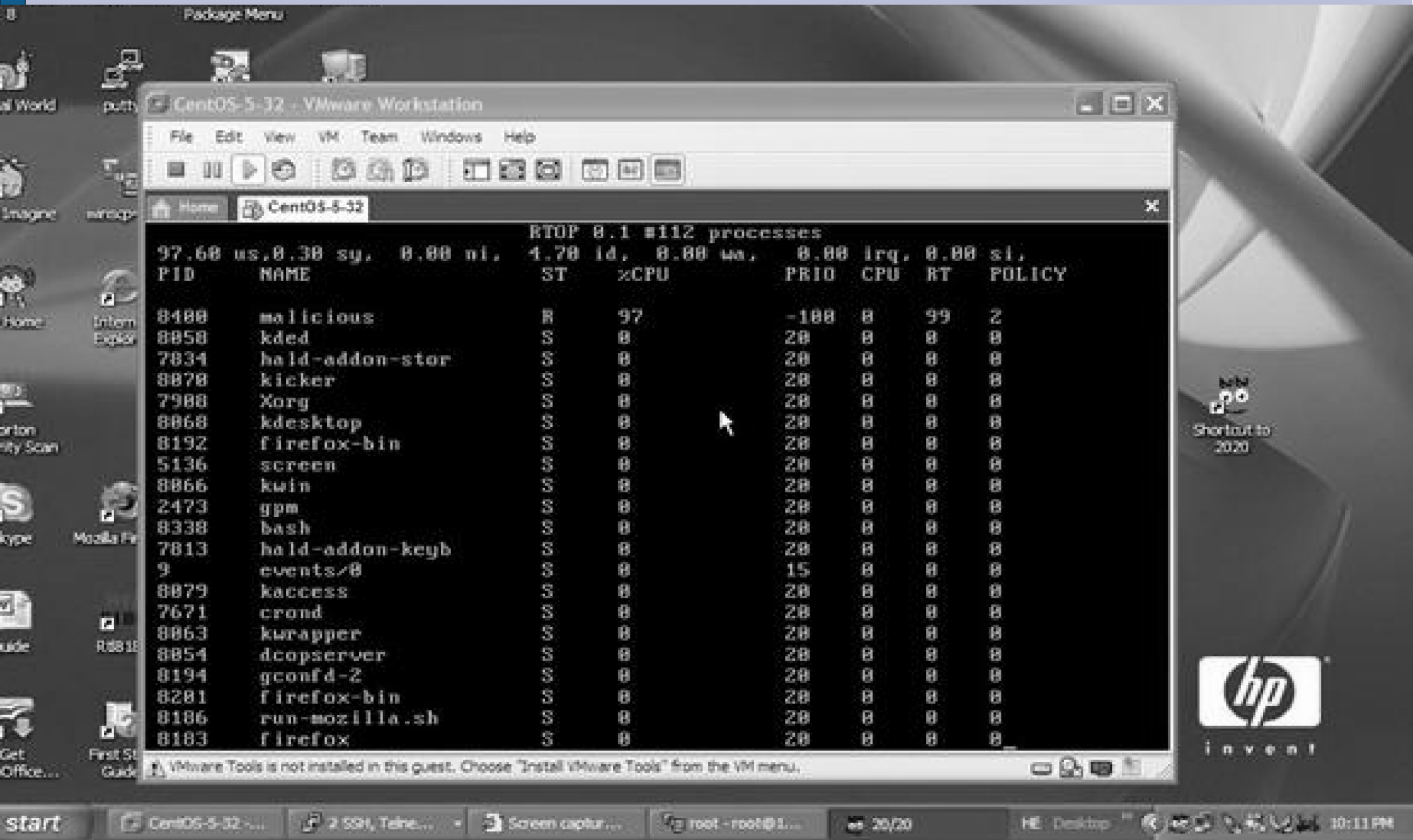
pros
1. the timer interrupt might be nested.
2. amount of work is too much to be handled in interrupt context.
3. Timer deadline varies bellow the defined resolution
4. No HPET available
5. 3% HPET overhead is too much.

ISOLATION EXAMPLE - RTOP

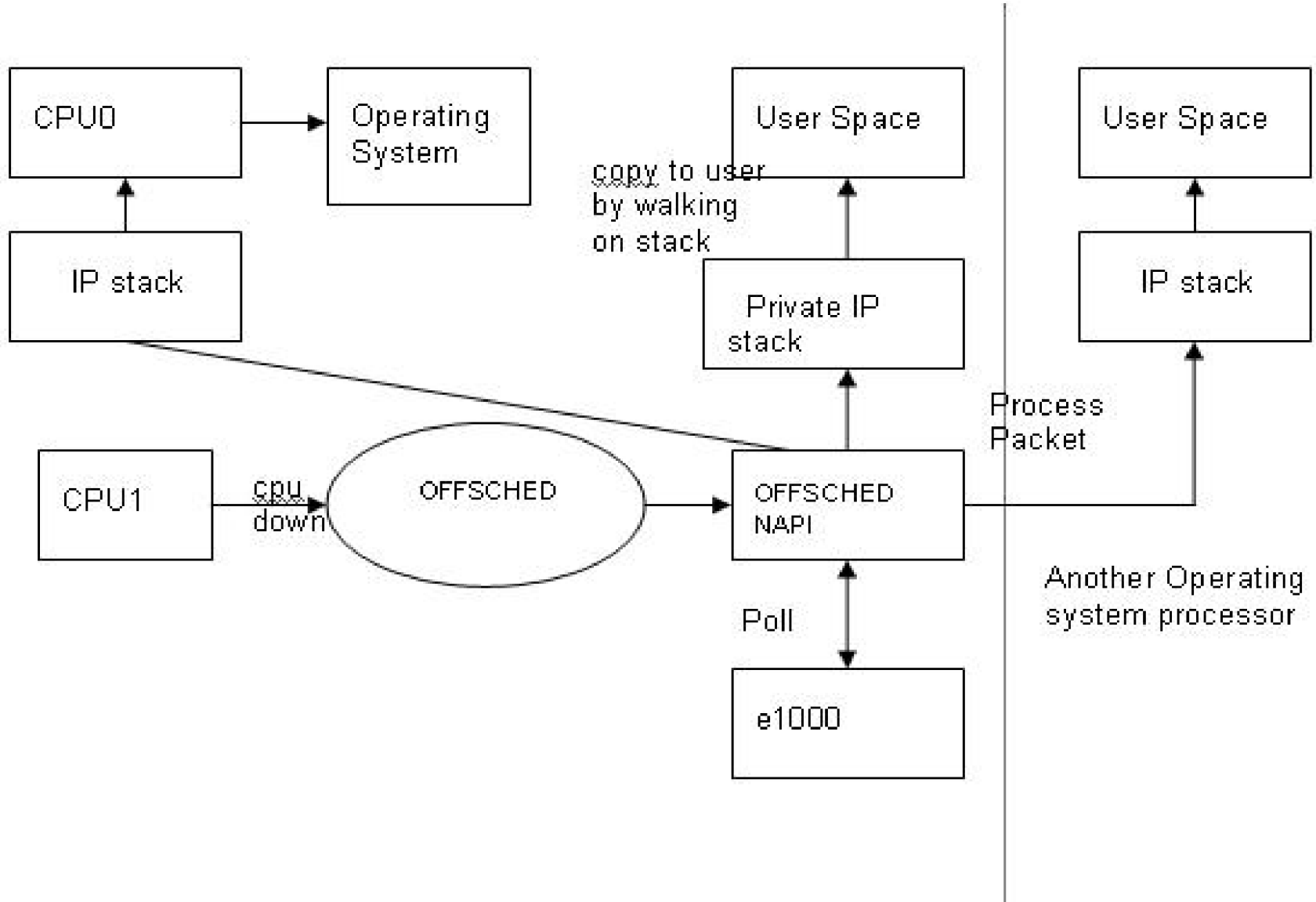
How do we know what happens in a system when this system is not accessible ?

OFFLINE solution: run a monitoring tool outside the operating system.

ISOLATION EXAMPLE - RTOP



ISOLATION EXAMPLE – OFFLINE NAPI



ISOLATION EXAMPLE – OFFLINE NAPI

Pros
1. RX disabling latency
2. IRQ masking latency
3. Rotting Packet
4. SMP IRQ affinity

Cons
cost a processor

USES

1. HIGH VOLUME DEVICES

2. DELICATE LATENCY IN KERNEL SPACE

3. INTEL I/OAT DMA LIKE

Acknowledgments

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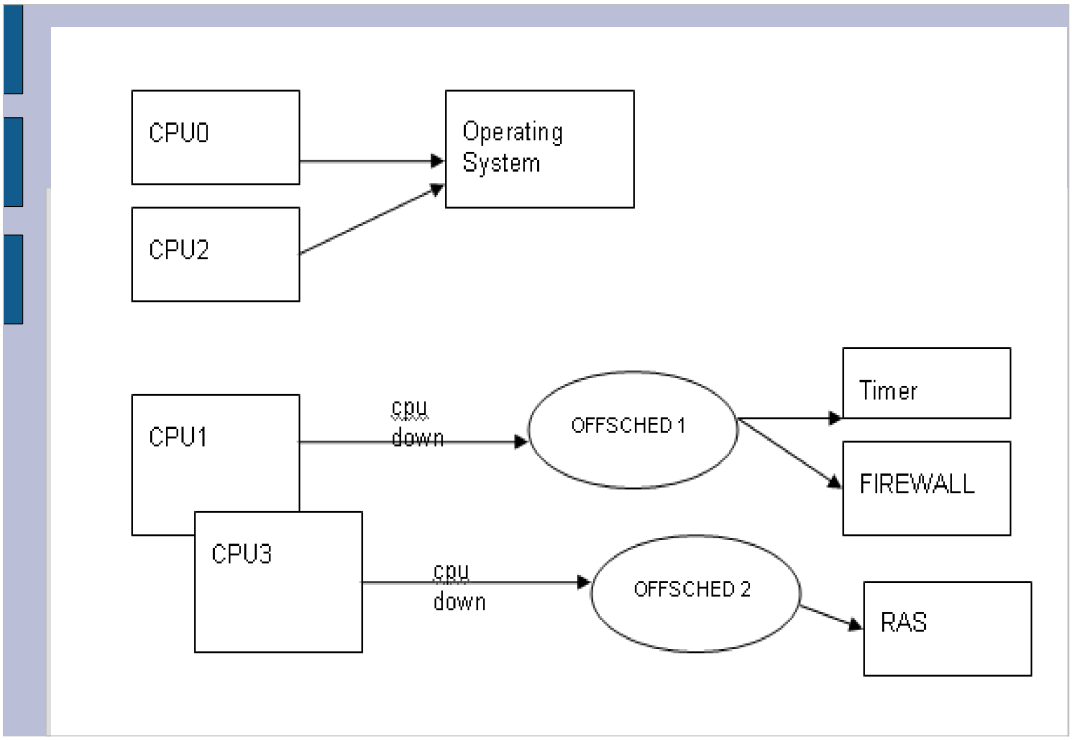
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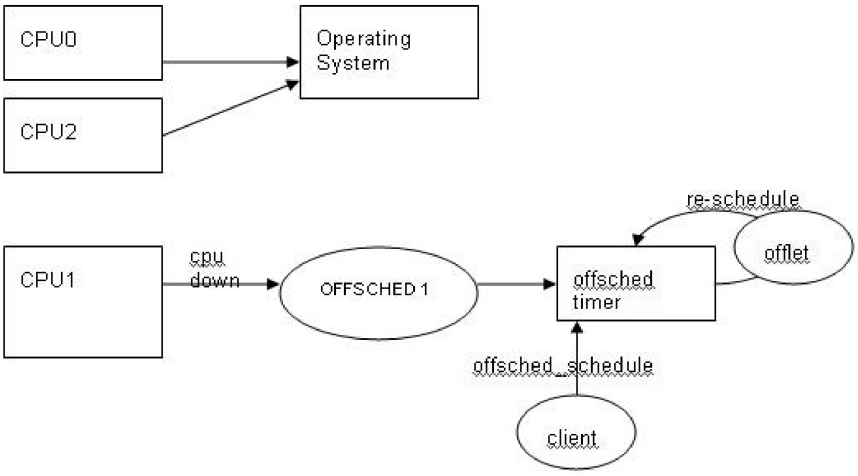

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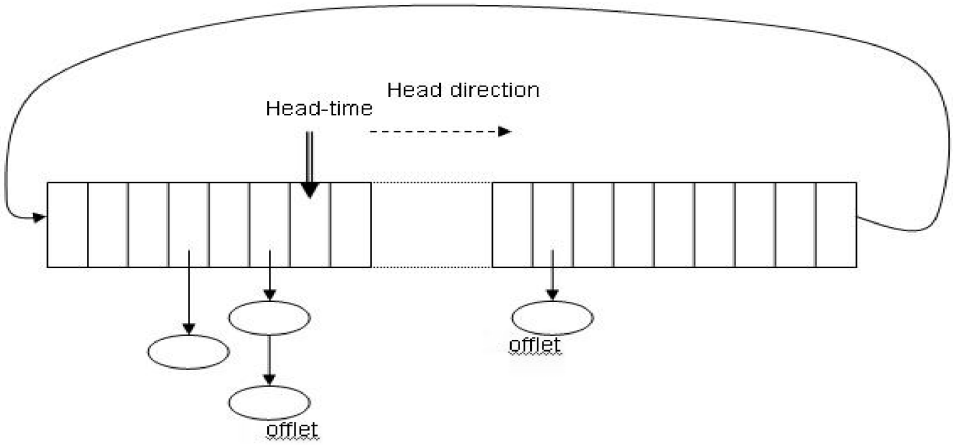

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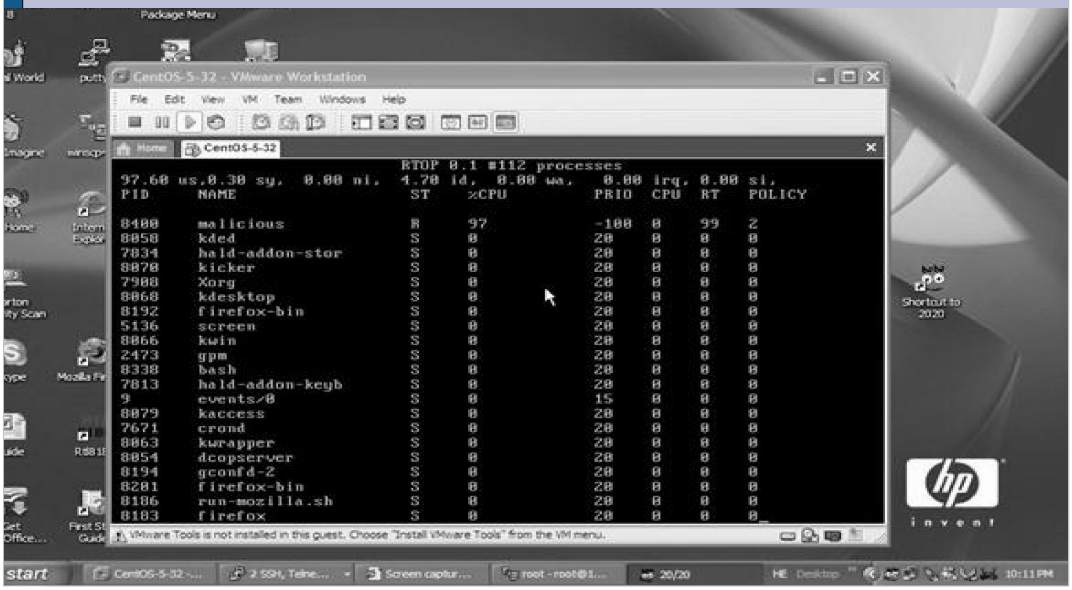

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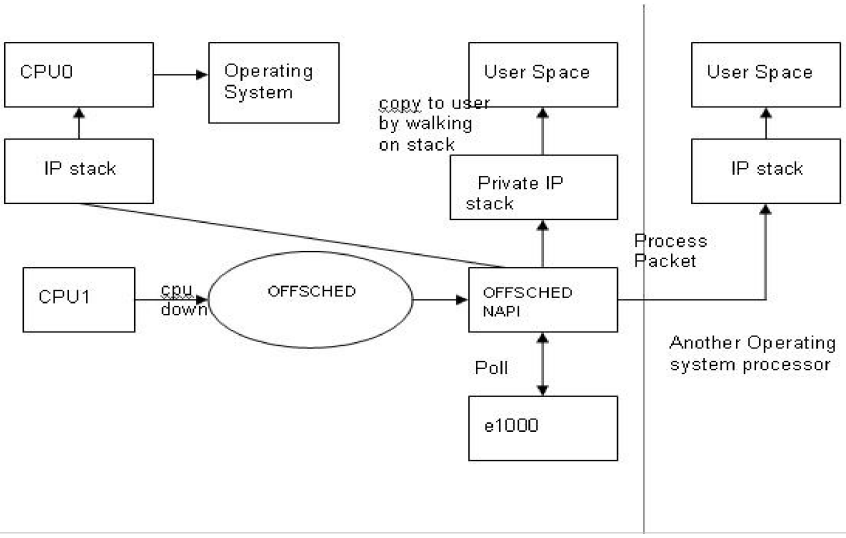

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