arm

Energy Aware Scheduling

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Introduction

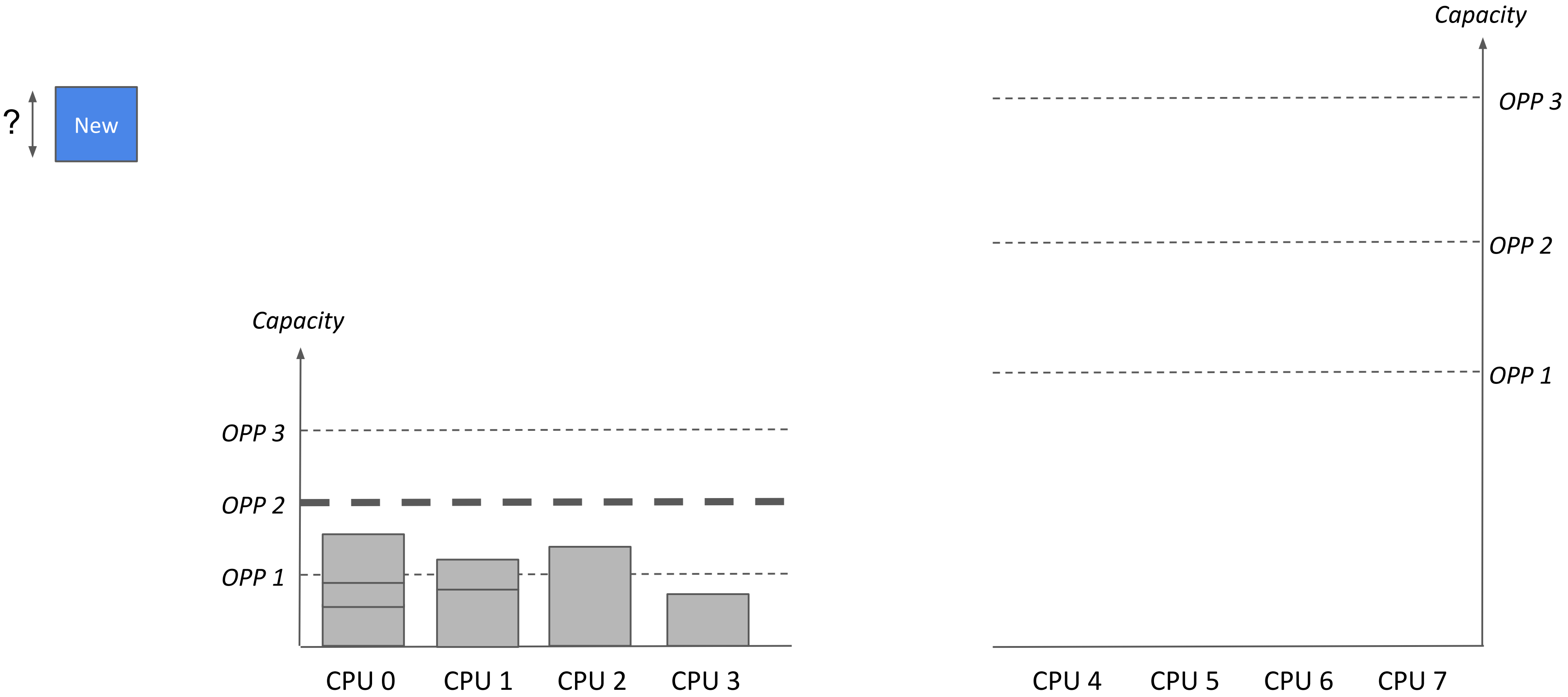
- Short history of Energy Aware Scheduling (EAS) patch-set
  - 2014/15: Patch-sets with active and idle energy costs data for CPUs and clusters
  - 2018: Patch-sets with active energy costs data for CPUs only and separate Energy Model (EM) framework

- Current v8 patch-set is ready for mainlining
  - EAS has been used for ARM big.LITTLE platforms in Android products over years
  - v8 patch-set will be part of the v4.19 version of Android Common Kernel

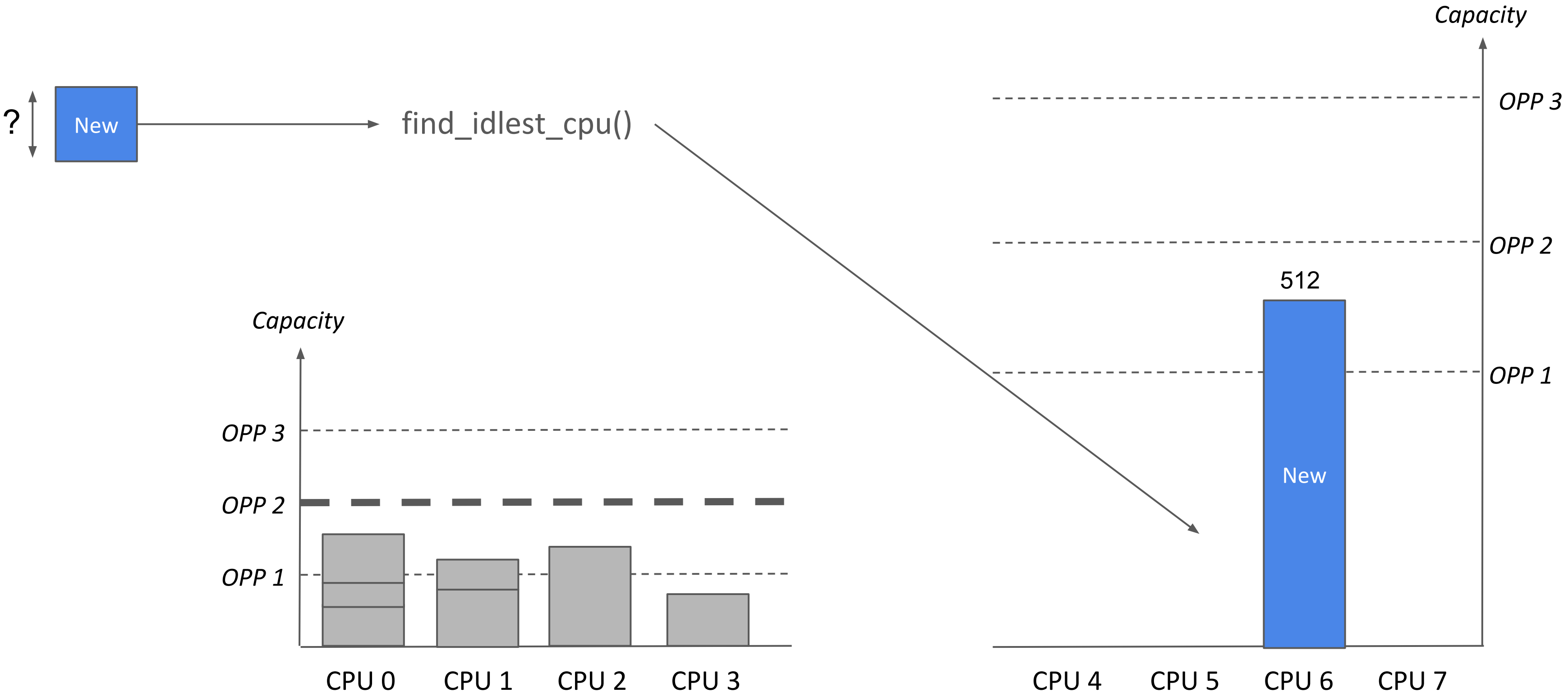
Possible future improvements

1. How to do task placement of new tasks ?
2. How to handle overutilization with new tasks ?
3. Should the EM deal with more than CPUs ?
4. Where should we compute $P = CV^2f$?

1. How to do task placement of new tasks?



1. How to do task placement of new tasks?



1. How to do task placement of new tasks?

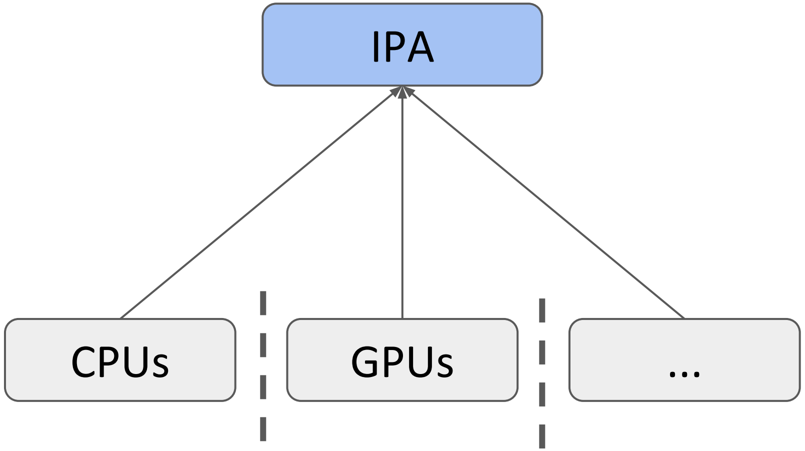
- Balancing options for new tasks ?
    - Just use the current slow path (find_idlest_cpu()) ?
    - “Predict” the util_avg of new tasks as per post_init_entity_util_avg() ?
    - Assume static initial util_avg (min_cap / 2 ? util_avg of parent ?)

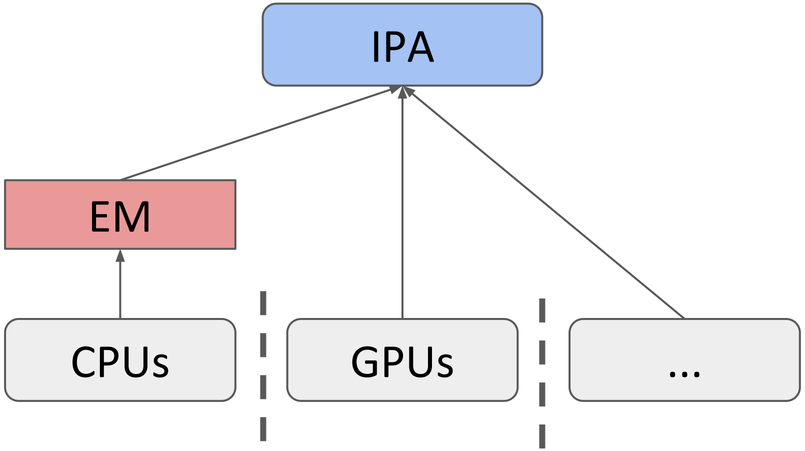
2. How to handle overutilization with new tasks

```
static void enqueue_task_fair(struct rq *rq, struct task_struct *p, int flags)
{

     ...

          if (flags & ENQUEUE_WAKEUP)
                         update_overutilized_status(rq);

     ...

}
```

- Wait for the PELT signal to ‘converge’ ?
- Initial util_avg value set to 0 ? Impact on frequency selection / initial EAS task placement ?

3. Should the EM deal with more than CPUs ?





4. Where should we compute $P = CV^2f$?

```
get_power(cpu,Hz,mW) {
    dpc = get_from_dt(...);
    V = pm_opp_get_voltage(Hz);
    mW = dpc * V * V * Hz;
}

cpufreq_init() {
    …
    em_register_perf_domain(cpus,
              nr_opp, &get_power);
    …
}
```

drivers/cpufreq/cpufreq-dt.c

```
cpu0 : {
  …
  dynamic-power-coefficient = … ;
  …
}
```

arch/arm64/boot/dts/xxx/platform.dts

4. Where should we compute $P = CV^2f$?

```
cpufreq_init() {
    …
    em_register_perf_domain(cpus,
       nr_opp, &pm_opp_get_power);
    …
}
```

*drivers/cpufreq/**scpi-cpufreq.c***

```
cpufreq_init() {
    …
    em_register_perf_domain(cpus,
       nr_opp, &pm_opp_get_power);
    …
}
```

*drivers/cpufreq/**arm_big_little.c***

```
cpufreq_init() {
    …
    em_register_perf_domain(cpus,
       nr_opp, &pm_opp_get_power);
    …
}
```

*drivers/cpufreq/**cpufreq-dt.c***

```
cpufreq_init() {
    …
    em_register_perf_domain(cpus,
       nr_opp, &pm_opp_get_power);
    …
}
```

drivers/cpufreq/ ????????

```
pm_opp_get_power(cpu,Hz,mW) {
    dpc = get_from_dt(...);
    V = pm_opp_get_voltage(Hz);
    mW = dpc * V * V * Hz;
}
```

drivers/pm_opp/of.c

```
cpu0 : {
  …
  dynamic-power-coefficient = … ;
  …
}
```

arch/arm64/boot/dts/xxx/platform.dts

arm