

Linux Thermal Sysfs Enhancement

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Motivation

- Improve performance for
 - Intel® Dynamic Platform and Thermal Framework
 - Linux Thermal Daemon
 - Other user space tools
- Add missing interfaces

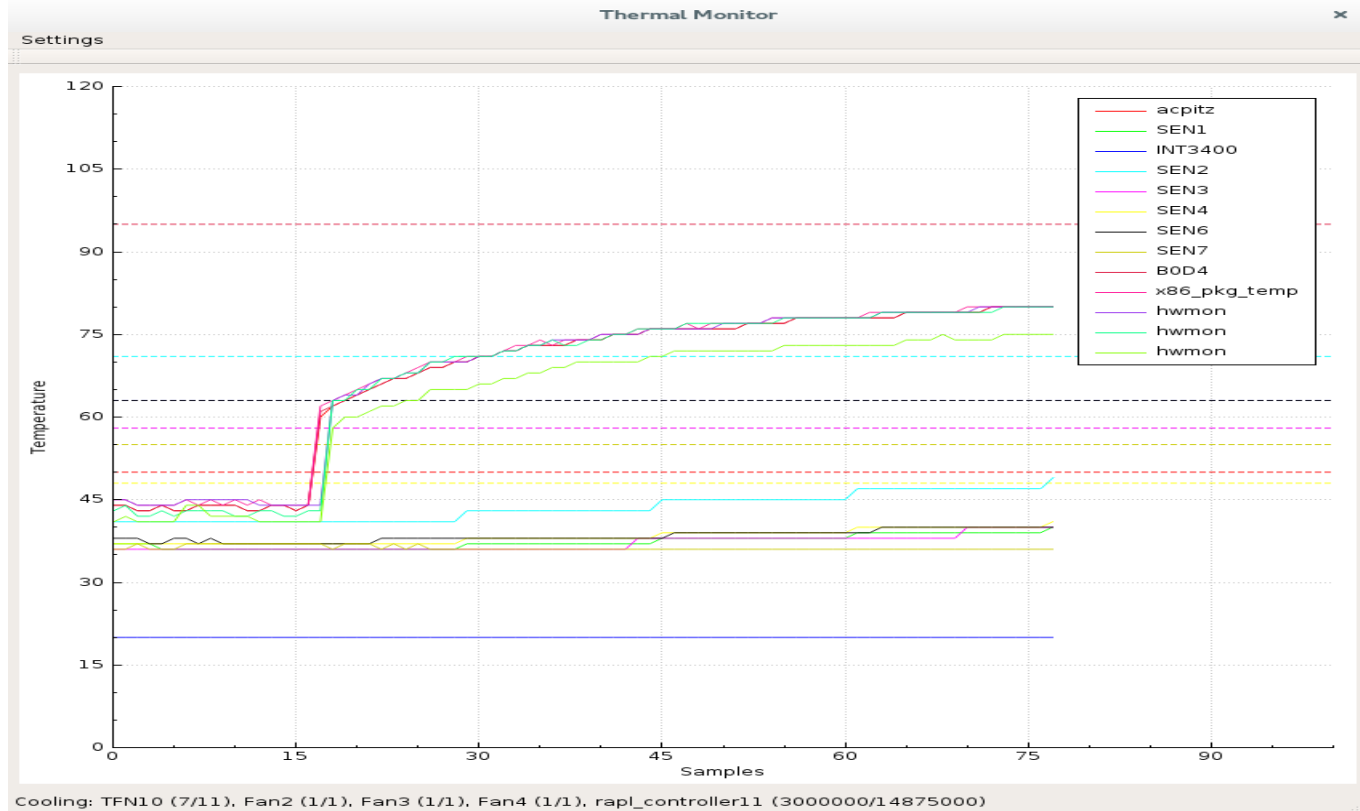
Agenda

- Thermal Management Complexity
- Linux Thermal Sysfs overview
- Limitations of thermal sysfs
- Thermal sysfs enhancements using IIO
- Example

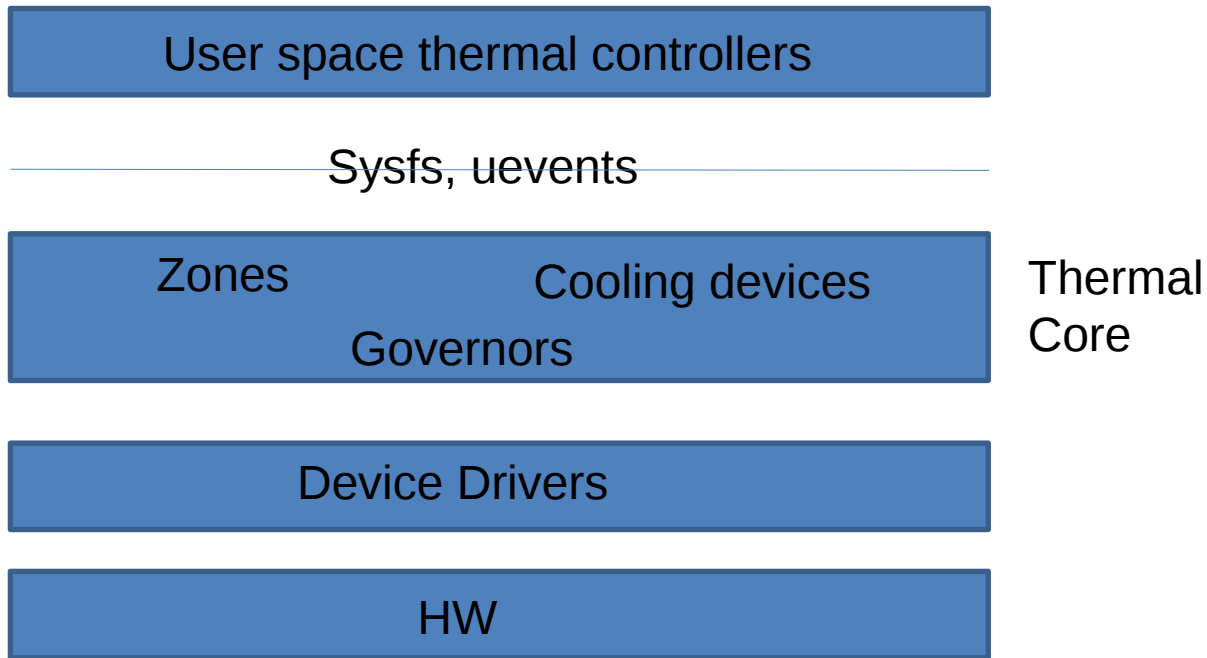
Thermal Management Complexity

- Thermal issues
 - No longer isolated conditions
 - Requires Pro-active approach
- Complex thermal relationships
- User space thermal controllers

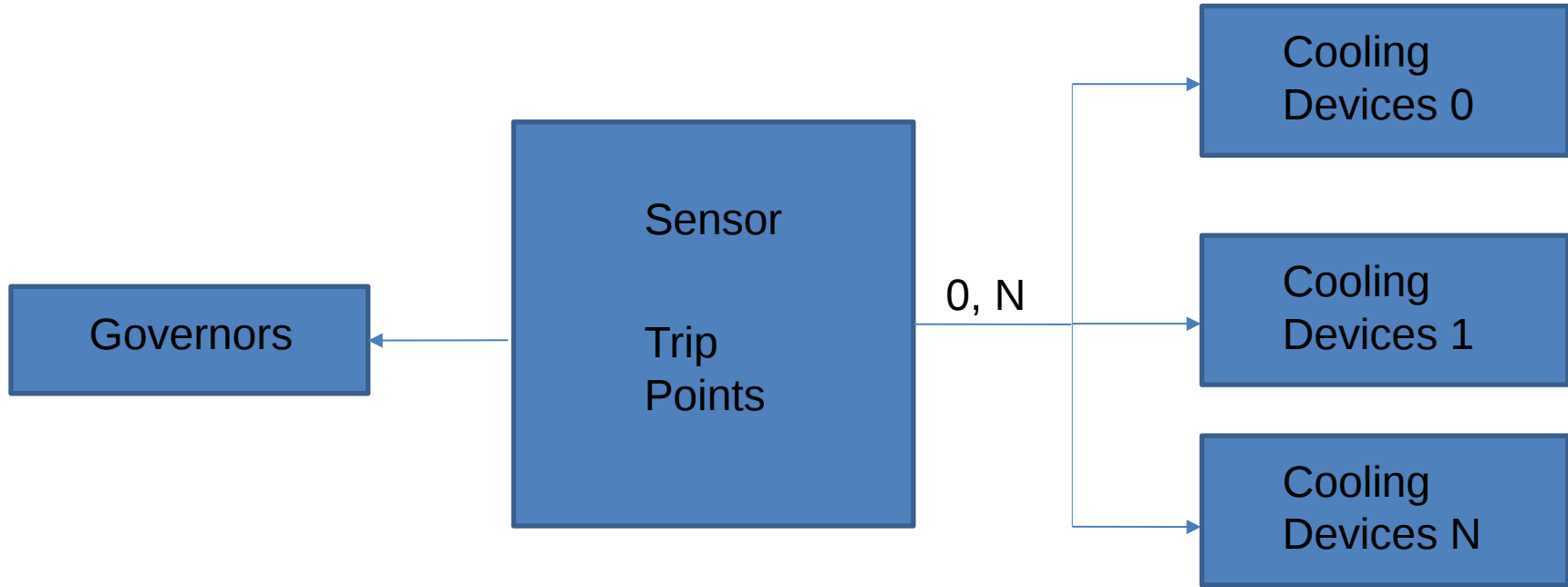
Thermal Management Example



Linux Thermal



Thermal Zone



Limitations of thermal sysfs

- Primarily developed for in-kernel monitoring and control
 - Temperature read via sysfs attribute
 - Performance impact due to polling
- Limited temperature change notification mechanism
 - Asynchronous event setting via RW trip point
 - Use kobject uevent
- Limited event support
 - Trip point changed
- Only Pull Interface support

Requirements

- Binary Read I/F
- Pollable/Selectable file node
- Specify thresholds without patching trip points
- Asynchronous events with reason code
- Controllable Samples triggered from external events

Solution

- Use Thermal Sysfs 2.0
Still can't meet requirements
- Invent/develop new I/F
- Use Existing I/F

Linux IIO features

- Basic device registration
- Polled access via sysfs
- Software ring buffers for samples
- Events specification and notification
- Triggered sampling from external events

Thermal IIO Binding

- Each Zone Sensor as IIO Device
- Optional registration during `thermal_zone_device_register`
- Push Samples to buffers from user space governor notify function
- New thermal driver callback for thresholds

RFC Patches

<http://marc.info/?l=linux-pm&m=143985565110987&w=2>

<http://marc.info/?l=linux-pm&m=143985565210989&w=2>

Thermal-IIO Sensor Example

```
spandruvada@spandruv-mobl2:/sys/class/thermal/thermal_zone7$ tree -L
```

```
1
```

```
.  
├── emul_temp  
├── iio:device7  
├── policy  
├── power  
├── subsystem -> ../../../../class/thermal  
├── temp  
├── trigger7  
├── trip_point_0_temp  
├── trip_point_0_type  
├── trip_point_1_temp  
├── trip_point_1_type  
├── type = "x86_pkg_temp"  
└── uevent
```

Thermal-IIO Sensor Example

```
spandruvada@spandruv-mobl2:/sys/class/thermal/thermal_zone7$ tree -L 1 iio\:device7
```

```
iio:device7
├── buffer
├── dev
├── events
├── in_temp_raw
├── name = "x86_pkg_temp"
├── power
├── scan_elements
├── subsystem -> ../../../../bus/iio
├── trigger → current_trigger
└── uevent
```

Device node = /dev/iio:device7

Thermal-IIO Sensor Example

```
spandruvada@spandruv-mobl2:/sys/class/thermal/thermal_zone7$ tree -L 1
```

```
iio\:device7/buffer/
```

```
iio\:device7/buffer/
```

```
├── enable "0/1"  
├── length  
└── watermark
```


Thermal-IIO Sensor Example

```
spandruvada@spandruv-mobl2:/sys/class/thermal/thermal_zone7$ tree -L 1
```

```
iiio\device7/scan_elements/
```

```
iiio:device7/scan_elements/
```

```
├── in_temp_en = "0/1"  
├── in_temp_index = "0"  
└── in_temp_type = "le:u32/32>>0"
```

Thermal-IIO Sensor Example

```
spandruvada@spandruv-mobl2:/sys/class/thermal/thermal_zone7$ tree -L 1
iio\:device7/events
iio:device7/events
├── in_temp_thresh_either_en = "0/1"
└── in_temp_thresh_either_value = "Temperature threshold value"
```

Thermal-IIO Sensor Example

```
spandruvada@spandruv-mobl2:/sys/class/thermal/thermal_zone7$ tree -L 1
trigger7/
trigger7/
├── name = "x86_pkg_temp-dev7"
├── power
├── subsystem -> ../../../../bus/iio
└── uevent
```

Thermal-IIO Sensor Example

```
root@spandruv-mobl2:/sys/devices# tree -L 1
iio_sysfs_trigger
iio_sysfs_trigger
├── add_trigger
├── power
├── remove_trigger
├── subsystem -> ../../bus/iio
├── trigger14
└── uevent
```

Thermal-IIO Sensor Example

```
root@spandruv-mobl2:/sys/devices/iio_sysfs_trigger/trigger14# tree -L  
1
```

```
.  
├── name = "sysfstrig1"  
├── power  
├── subsystem -> ../../../../bus/iio  
├── trigger_now  
├── trigger_poll  
└── uevent
```

```
root@spandruv-mobl2:/sys/devices/iio_sysfs_trigger/trigger14# echo 1 > trigger_now  
root@spandruv-mobl2:/sys/devices/iio_sysfs_trigger/trigger14# echo 5000 > trigger_poll
```

Q & A