

Agenda

- CPU hotplug introduction
- Design concepts
- Design criteria
- Source code architecture
 - Strategy
- Algorithm

CPU Hotplug

- A trade-off between maximum performance and lower power.
 - Turn off cores if system loading is low.
 - For low power.
 - Turn on cores if system loading is high.
 - For performance.

Design Concepts

- Strategy in kernel space to reduce overhead [*].
- Little first, except scheduler indication (heavy task).
 - Low power preferred.
- CPU Rush boost / Quick Landing
 - 2 steps if across clusters.

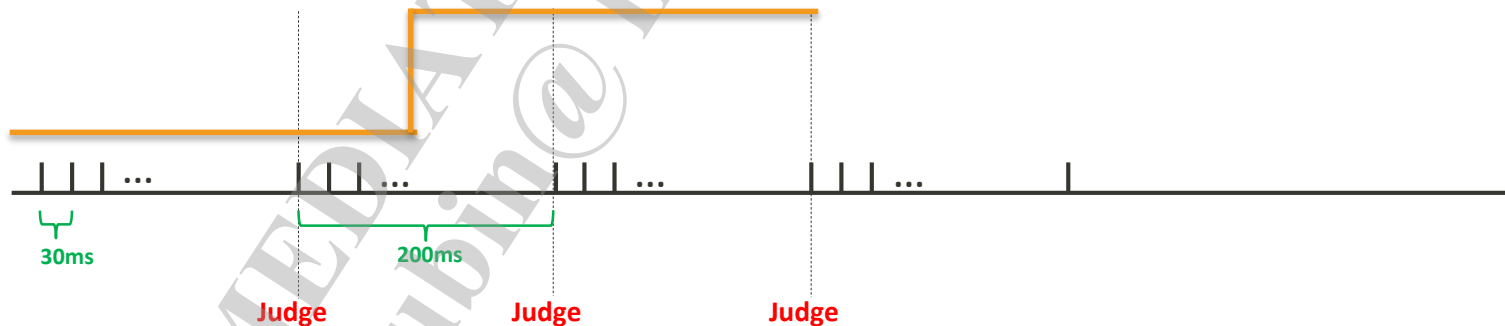
Design Criteria

- **1 RT 96 thread**
 - Calculate loadings
 - Hotplug strategy
 - Hotplug action

- **100ms timer**
 - Up
 - 100ms
 - Down
 - 1s

Timer Impact

- CPU Hotplug Strategy use his own timer, 200ms by default.
 - Too long
 - react performance issue too slow.
 - Too short
 - CPUFreq impact too much – we should let DVFS react first.
 - Impact both low power and performance.



CPU Hotplug Loading Table

| | CPU Cores | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|------|----------------|-------|--------|--------|--------|--------|--------|--------|--------|
| Up | Total Loadings | > 80% | > 160% | > 240% | > 320% | > 400% | > 480% | > 560% | |
| Down | Total Loadings | | < 70% | < 140% | < 210% | < 280% | < 350% | < 420% | < 490% |

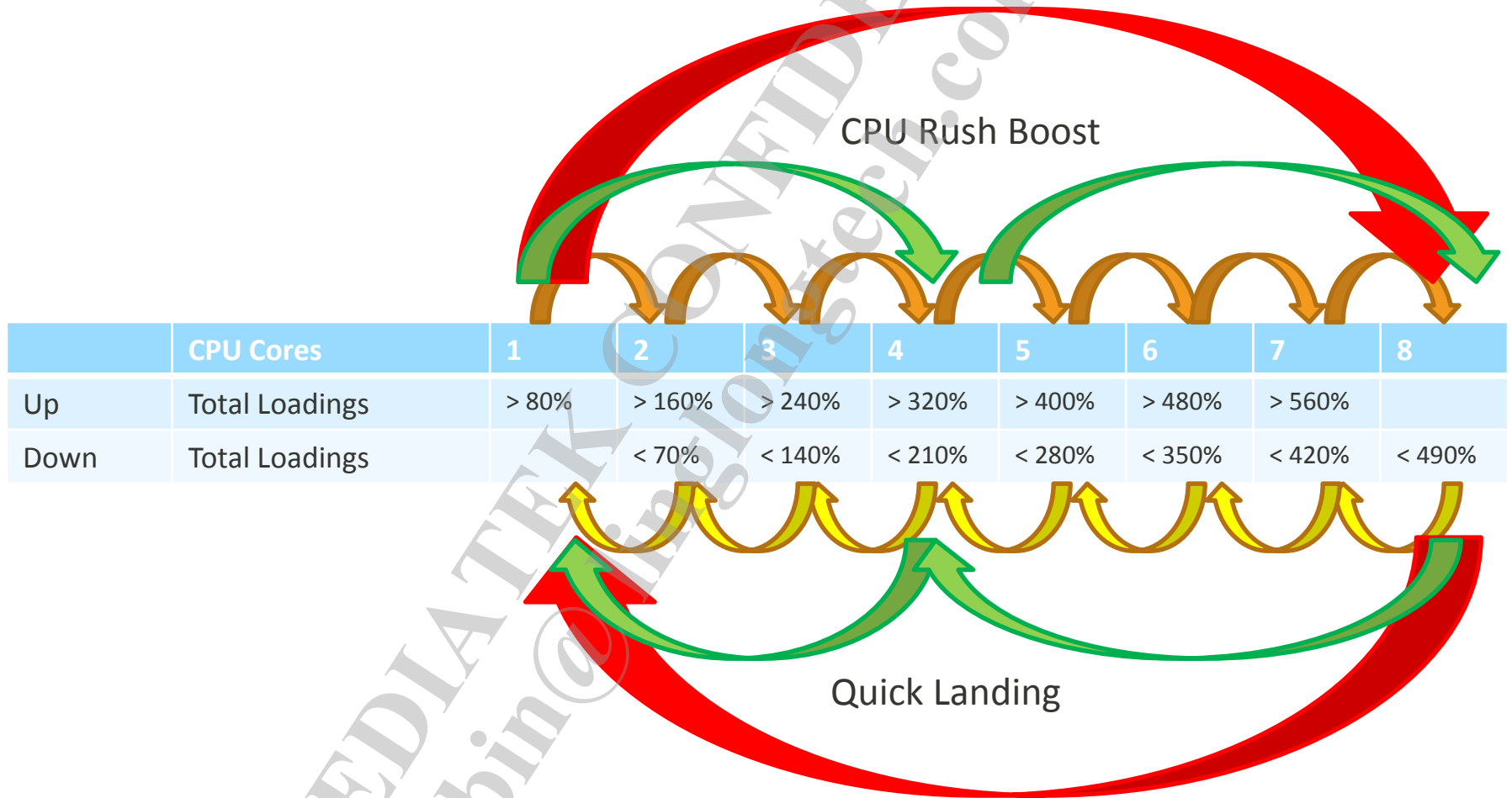
CPU Hotplug Loading Table

CPU Rush Boost

| | CPU Cores | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|------|----------------|-------|--------|--------|--------|--------|--------|--------|--------|
| Up | Total Loadings | > 80% | > 160% | > 240% | > 320% | > 400% | > 480% | > 560% | |
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Quick Landing

CPU Hotplug Loading Table



Parameters

compile time

| Name | Value |
|-----------------------|-----------------|
| HPS_TIMER_INTERVAL_MS | 100 |
| HPS_TASK_PRIORITY | MAX_RT_PRIO - 3 |

runtime

| Name | Value |
|------------------------------|-------|
| DEF_CPU_UP_THRESHOLD | 80 |
| DEF_CPU_UP_TIMES | 1 |
| DEF_CPU_DOWN_THRESHOLD | 70 |
| DEF_CPU_DOWN_TIMES | 10 |
| DEF_TLP_TIMES | 1 |
| EN_CPU_RUSH_BOOST | 1 |
| DEF_CPU_RUSH_BOOST_THRESHOLD | 98 |
| DEF_CPU_RUSH_BOOST_TIMES | 1 |

Parameters

- Default settings in source code:
 - drivers/misc/mediatek/base/power/mt8167/mt_hotplug_strategy_internal.h
 - #define HPS_TASK_PRIORITY (MAX_RT_PRIO - 3)
 - #define HPS_TIMER_INTERVAL_MS (100)
 - #define DEF_CPU_UP_THRESHOLD (80)
 - #define DEF_CPU_UP_TIMES (1)
 - #define DEF_CPU_DOWN_THRESHOLD (70)
 - #define DEF_CPU_DOWN_TIMES (10)
 - #define DEF_TLP_TIMES (1)
 - #define EN_CPU_RUSH_BOOST (1)
 - #define DEF_CPU_RUSH_BOOST_THRESHOLD (98)
 - #define DEF_CPU_RUSH_BOOST_TIMES (1)

Parameters

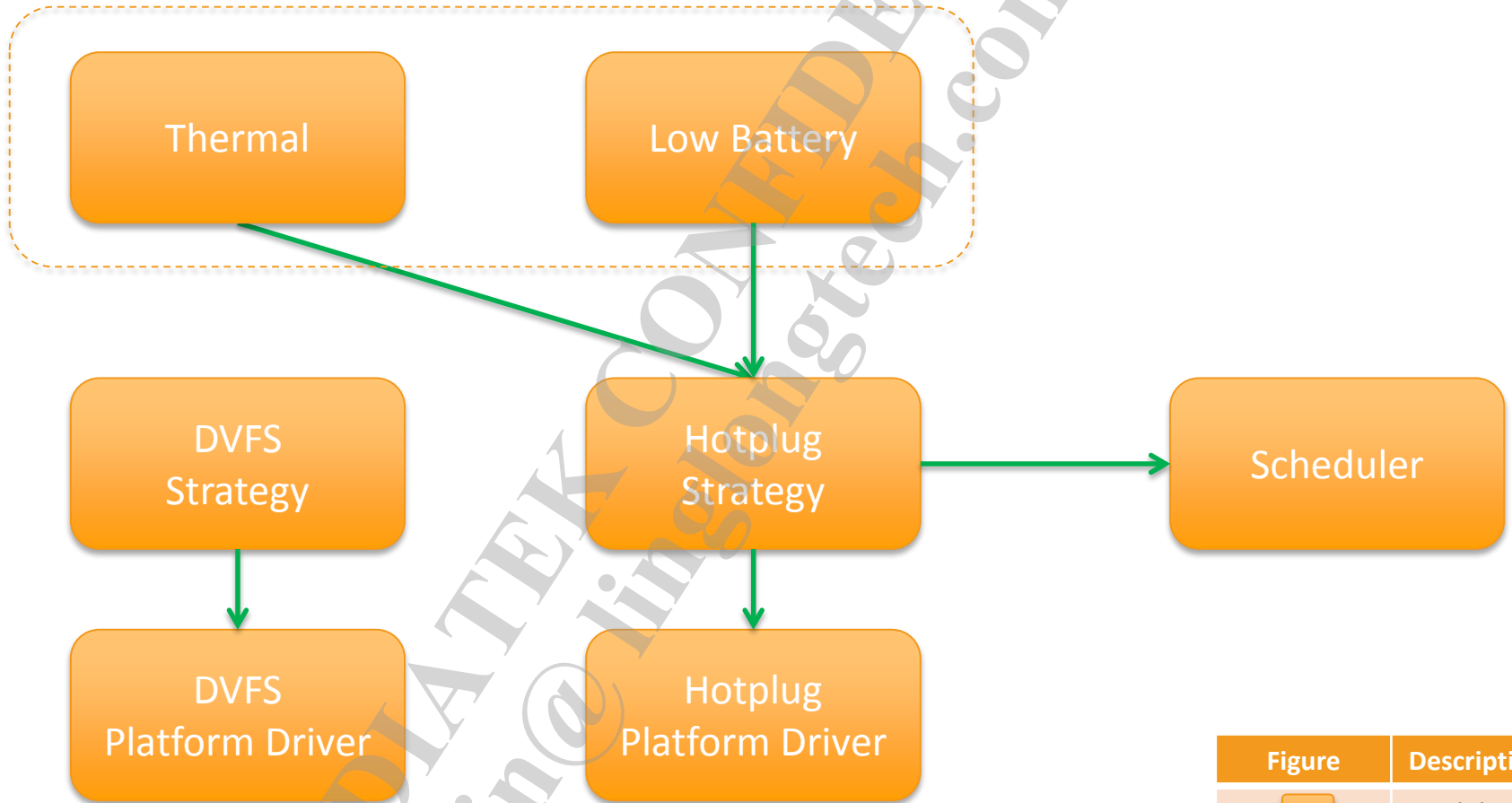
- Read / control parameters through procfs:
 - /proc/hps/*:
 - down_threshold
 - down_times
 - enabled
 - rush_boost_enabled
 - rush_boost_threshold
 - rush_boost_times
 - tlp_times
 - up_threshold
 - up_times



Parameters

- Read / control parameters through procfs:
 - Examples:
 - Disable hotplug strategy:
 - `echo 0 > /proc/hps/enabled`
 - See hotplug strategy is enabled:
 - `cat /proc/hps/enabled`
 - Set / show CPU_DOWN_THRESHOLD:
 - `echo 70 > /proc/hps/down_threshold`
 - `cat /proc/hps/down_threshold`

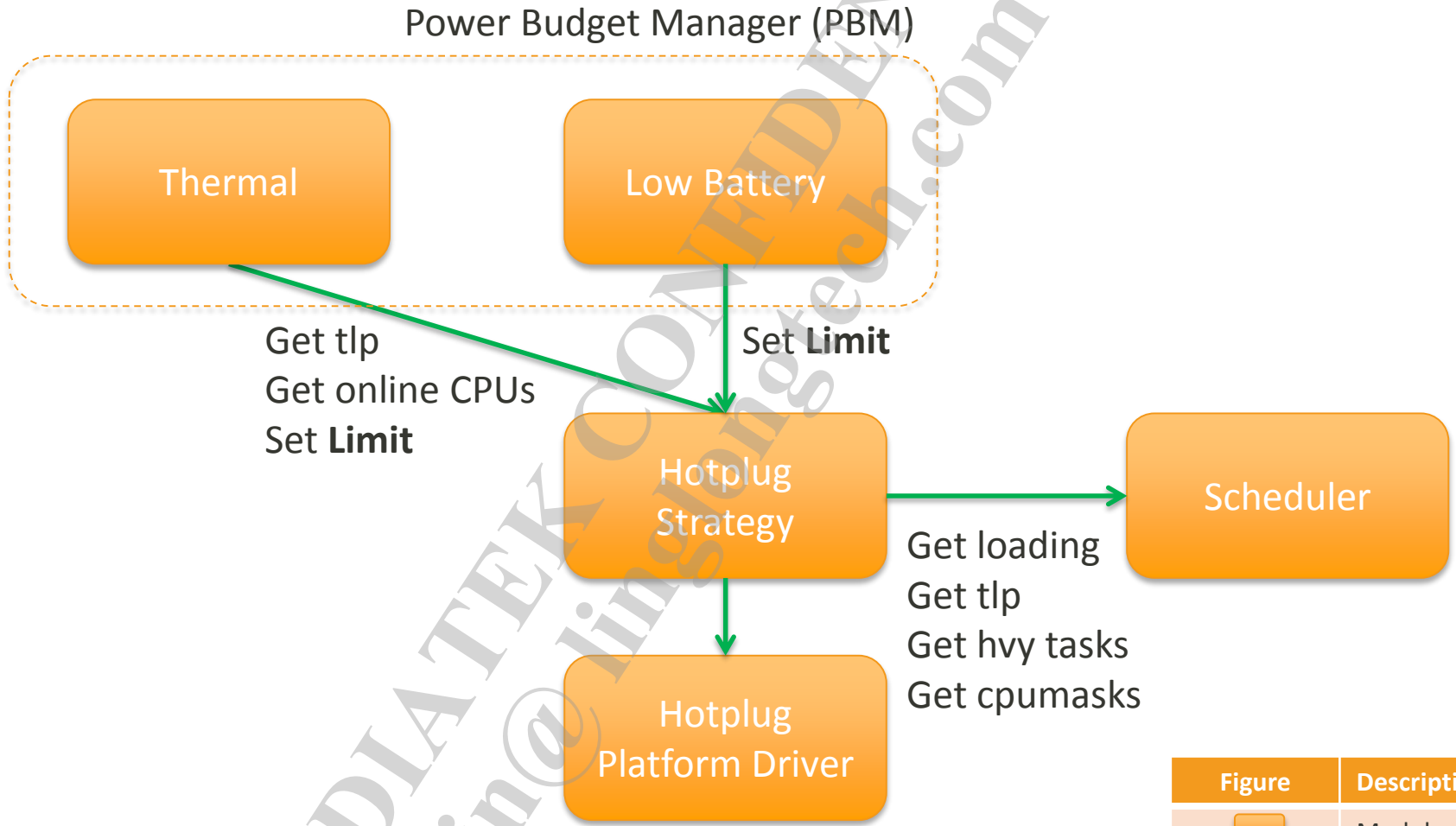
Block Diagram

Power Budget Manager (PBM)



| Figure | Description |
|---|-------------|
|  | Module |
|  | Use |

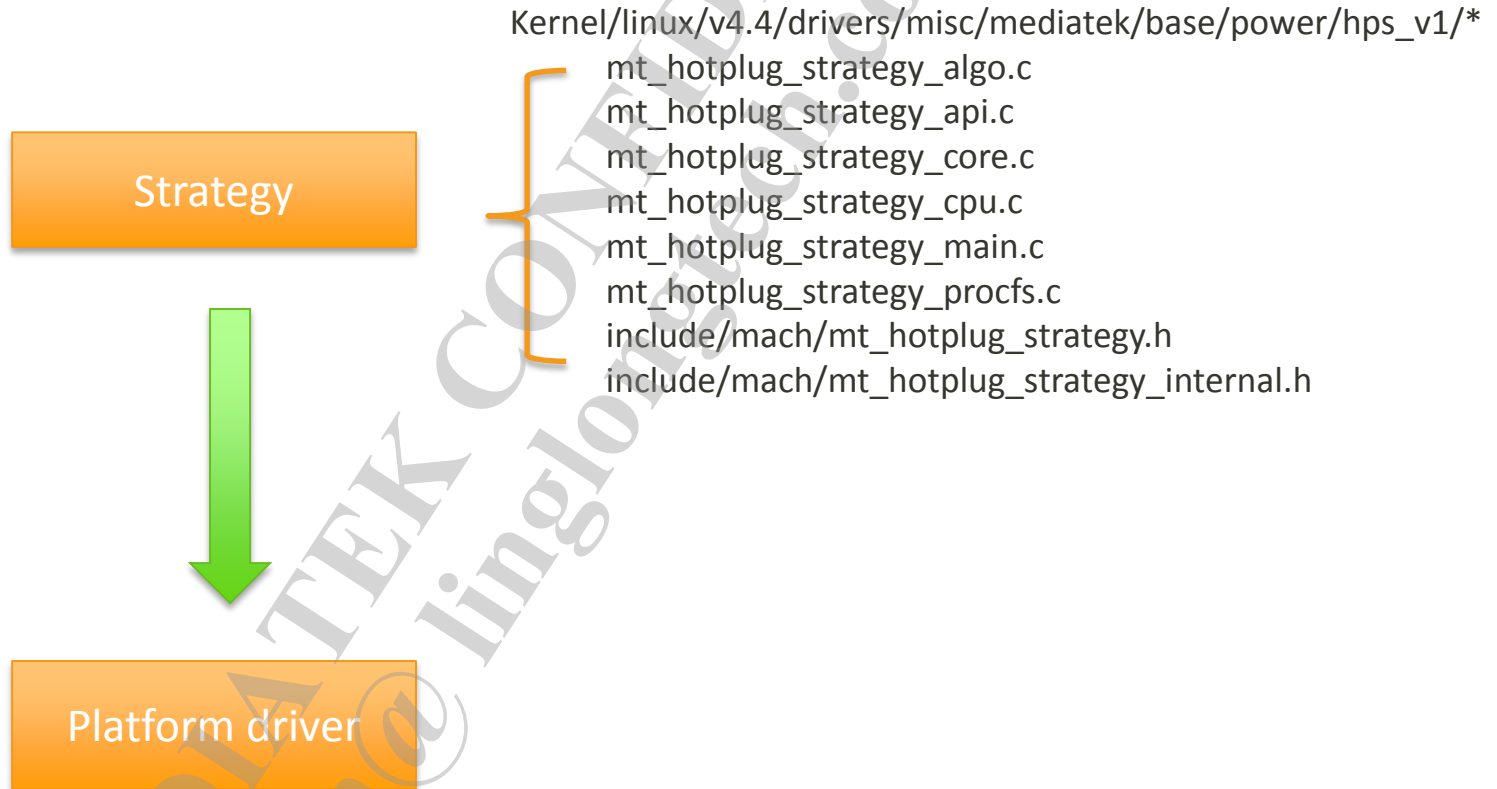
Block Diagram





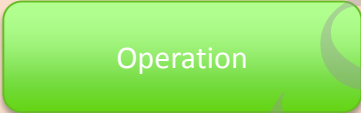
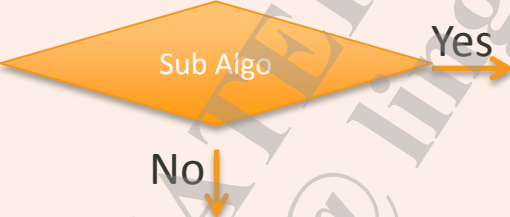

| Figure | Description |
|--------|-------------|
| | Module |
| | Use |

CPU Hotplug

Source code architecture



Algo - Pictogram Description

| Pictogram | Description |
|---|-------------|
|  | Algo Begin |
|  | Algo End |
|  | Operation |
|  | Sub Algo |
|  | Algorithm |

Main Algorithm

CPU Up

RUSH_Boost algorithm

- Turn on cores by system loading.

CPU Down / quick landing

- Turn off cores by system loading.

Thermal/Battery algo.

- Limit maximum online cores.

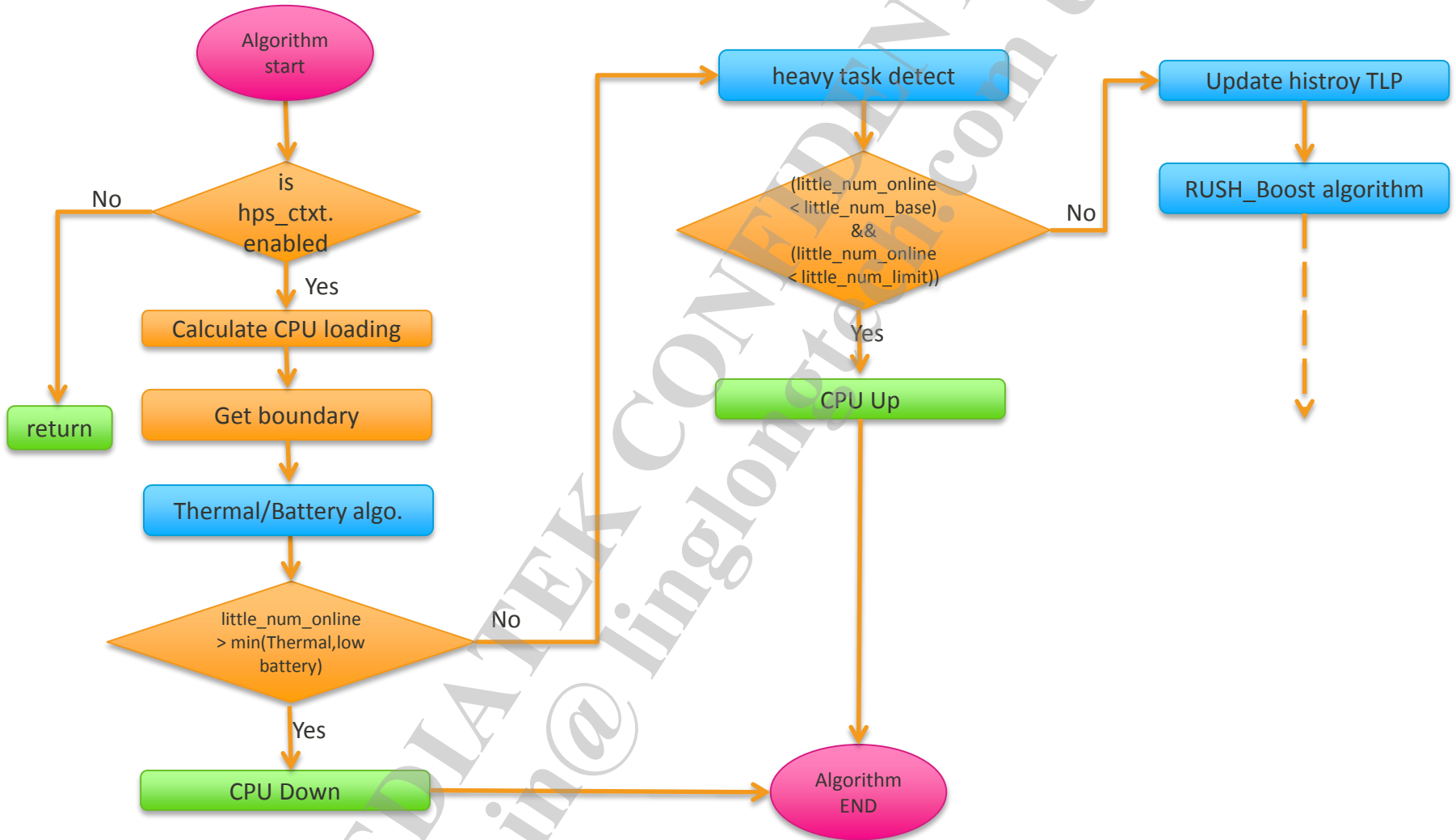
heavy task detect

- Limit minimum online cores.

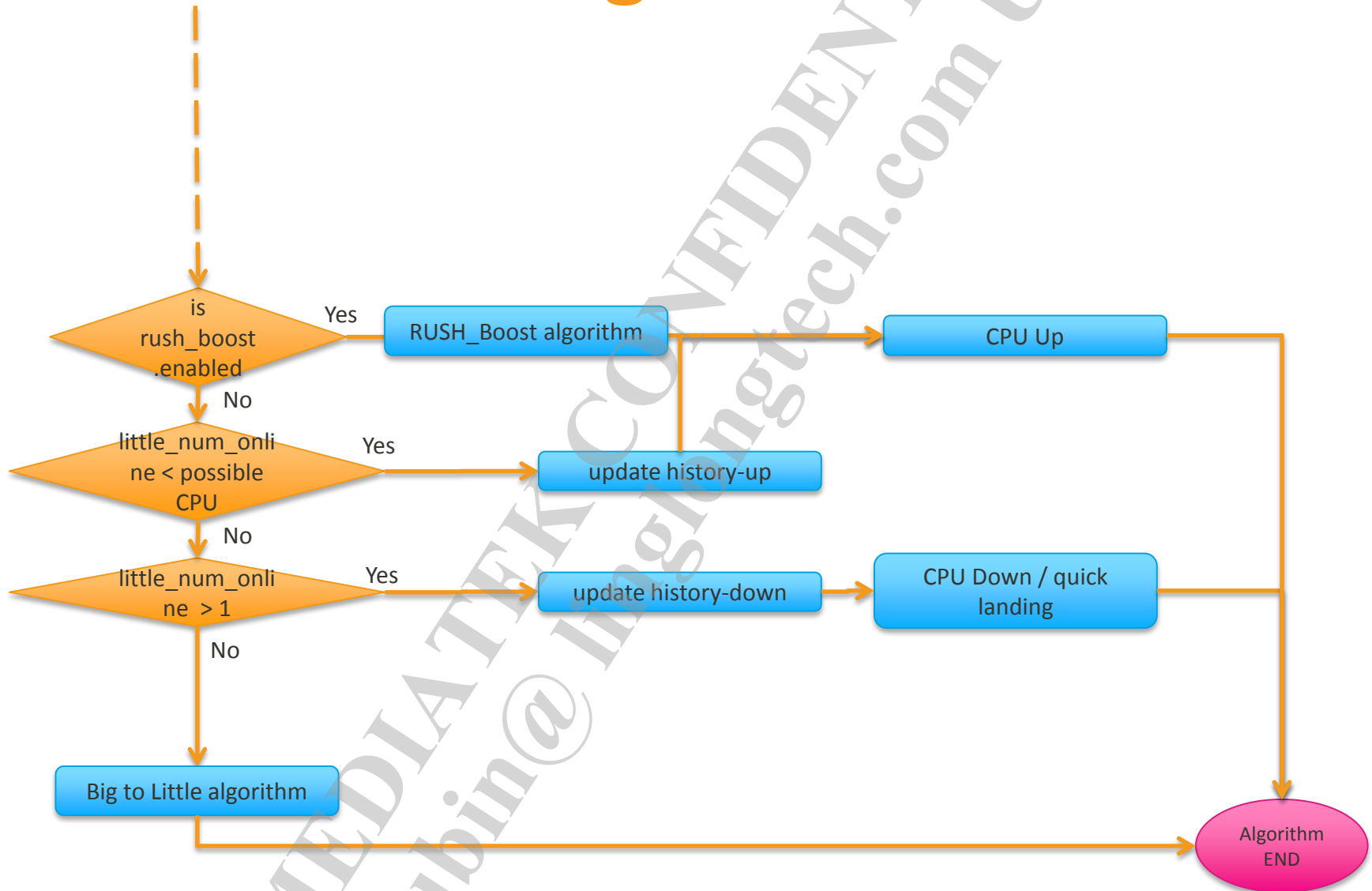
Big to Little algorithm

- Turn on a little core and turn off a big core for power saving.

Algorithm



Algorithm



Tips

Commands:

- Get cpu core : `cat /sys/devices/system/cpu/possible`
- Check online cpu core: `cat /sys/devices/system/cpu/online`
- Enable cpu core:
 `echo 0 > /proc/hps/enabled //disable cpu core`
 `echo 1 > /sys/devices/system/cpu/cpuX/online //enable cpu core`
X(mt8516 can use 0/1/2/3)

MEDIA TEK

everyday genius