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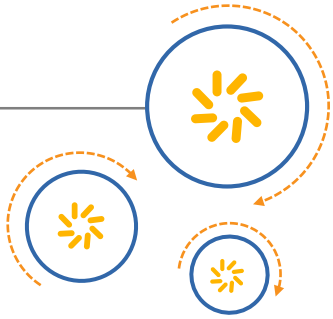

DragonBoard™ 410c based on Qualcomm® Snapdragon™ 410 processor

Processor Governor Guide

June 2015

Questions or comments: https://www.96boards.org/DragonBoard410c/forum

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Revision history

Revision	Date	Description
C	June 11, 2015	Miscellaneous updates.
B	May 22, 2015	Updated Revision history and © date.
A	April 22, 2015	Initial release.

Contents

1 Introduction

1.1 Purpose

The purpose of this document is to understand the governor parameters of the interactive governor and how they work with DragonBoard 410c. Interactive governor is a system daemon that dynamically scales CPU clock speed in response to the workload placed on the CPU by the user.

This document also explains CPU boost parameters for Qualcomm Snapdragon 410 processor.

1.2 Scope

This document is written for engineers who need to understand the process for collecting system profiling data for QoS-related issues. The scope is limited to the Android platform.

1.3 Conventions

Function declarations, function names, type declarations, and code samples appear in a different font, e.g., `#include`.

1.4 Additional information

For additional information, go to https://www.96boards.org/DragonBoard410c/docs.

2 CPU Governors

2.1 What is a CPUFreq governor?

Most cpufreq drivers (in fact, all accept one, longrun) or even most cpu frequency scaling algorithms offer the CPU to be set to one frequency. To offer dynamic frequency scaling, the cpufreq core must be able to tell these drivers of a "target frequency." So these specific drivers will be transformed to offer a "->target/target_index" call instead of the existing "->setpolicy" call. For "longrun," all stays the same, though.

2.2 Available CPU governors

The node to read the available governors is /sys/devices/system/cpu/cpufreq/cpu0/cpufreq/scaling_available_governors. The available CPU Governors on 8016 SBC are:

1. **Performance:** The CPUfreq governor "performance" sets the CPU statically to the highest frequency within the borders of scaling_min_freq and scaling_max_freq.
2. **Powersave:** The CPUfreq governor "powersave" sets the CPU statically to the lowest frequency within the borders of scaling_min_freq and scaling_max_freq.
3. **Userspace:** The CPUfreq governor "userspace" allows the user, or any userspace program running with UID "root," to set the CPU to a specific frequency by making a sysfs file "scaling_setspeed" available in the CPU-device.
4. **Ondemand:** The CPUfreq governor "ondemand" sets the CPU depending on the current usage. The node to read these parameters is located at /sys/devices/system/cpu/cpufreq/ondemand. The sysfs file accessible parameters are:
   - **sampling_rate:** This is how often you want the kernel to look at the CPU usage and to make decisions on what to do about the frequency.
   - **sampling_rate_min:** The sampling rate is limited by the HW transition latency or by kernel restrictions.
   - **up_threshold:** Defines what the average CPU usage between the samplings of 'sampling_rate' needs to be for the kernel to make a decision on whether it should increase the frequency.
   - **ignore_nice_load:** This parameter takes a value of '0' or '1'. When set to '0' (its default), all processes are counted towards the 'cpu utilization' value. When set to '1', the processes that are run with a 'nice' value will not count (and thus be ignored) in the overall usage calculation.
   - **sampling_down_factor:** This parameter controls the rate at which the kernel makes a decision on when to decrease the frequency while running at top speed. When set to 1 (the default) decisions to reevaluate load are made at the same interval regardless of current clock speed. But when set to greater than 1 (e.g., 100) it acts as a multiplier for

the scheduling interval for reevaluating load when the CPU is at its top speed due to high load. This improves performance by reducing the overhead of load evaluation and helping the CPU stay at its top speed when truly busy.

- **powersave_bias:** This parameter takes a value from 0 to 1000. It defines the percentage (times 10) value of the target frequency that will be shaved off of the target.

5. **Interactive:** The CPUfreq governor "interactive" is designed for latency-sensitive, interactive workloads. This governor sets the CPU speed depending on usage, similar to "ondemand" governor, but with a different set of configurable behaviors. The node to read these parameters is located at /sys/devices/system/cpu/cpufreq/interactive. The tunable values for this governor are:

   - **target_loads:** The CPU frequency is adjusted to achieve this load. Target_loads also accepts strings as arguments such that it can be different for different values of current frequency.

     For example, the string '85 1000000:90 1700000:99' would mean:

     target_loads = 85, if cur_freq < 1 GHz

     90, if 1 GHz < cur_freq < 1.7 GHz

     99, if cur_freq > 1.7 GHz

     The higher the target_loads value for a particular frequency, the lower the next frequency picked so that the load is achieved until the next. The lower the target_loads, the more often the governor will raise CPU speeds to bring the load below the target.

   - **Hispeed_freq:** The intermediate frequency to jump in case the load exceeds 'go_hispeed_load'. If the load stays high for the amount of time specified in above_hispeed_delay, then the speed may be bumped higher.

   - **Go_hispeed_load:** If the load exceeds this value, then the next frequency chosen is at least hispeed.

   - **Above_hispeed_delay:** Keep the CPU frequency at hispeed_freq (or above) for min_sample_time before ramping up the frequency.

   - **Min_sample_time:** The minimum time interval to wait at any frequency before dropping to lower frequencies.

   - **Sampling_rate:** The sampling rate of the interactive governor. This is how often you want the kernel to look at the CPU usage and to make decisions on what to do about the frequency.

   NOTE: This parameter is not applicable for 8916

   - **Sampling_down_factor:** This parameter controls the rate at which the kernel makes a decision on when to decrease the frequency while running at top speed. When set to 1 (the default) decisions to reevaluate load are made at the same interval regardless of current clock speed. But when set to greater than 1 (e.g., 100) it acts as a multiplier for the scheduling interval for reevaluating load when the CPU is at its top speed due to high load. This improves performance by reducing the overhead of load evaluation and helping the CPU stay at its top speed when truly busy, rather than shifting back and forth in speed.

- **Sync_Freq Feature:** This feature will cause a CPU frequency to stay above a particular value sync_freq) if certain conditions (determined by the two nodes up_threshold_any_cpu_freq and up_threshold_any_cpu_load) are satisfied.
- **Up_threshold_any_cpu_freq:** If the maximum frequency across all the CPUs is higher than or equal to this frequency value, do not let the current CPU fall below sync_freq. The higher this value, the fewer the chances to go to sync_freq.
- **Up_threshold_any_cpu_load:** If the maximum load across all the CPUs is higher than or equal to this load value, do not let the current CPU fall below sync_freq. The higher this value, the fewer the chances to go to sync_freq.
- **Sync_freq:** Only when both of the above conditions are satisfied will the CPU not drop below this frequency value. The higher this value, the higher the frequency to jump will be when the above conditions are satisfied.

NOTE: This parameter is not applicable for 8916.

2.3 Switch between different governors

The node to read the current scaling governor is /sys/devices/system/cpu/cpufreq/cpu0/cpufreq/scaling_governor.

By default the scaling governor is interactive. Users can change the governor based on the load.

Echo ondemand > /sys/devices/system/cpu/cpufreq/cpu0/cpufreq/scaling_governor.

Cat /sys/devices/system/cpu/cpufreq/cpu0/cpufreq/scaling_governor—it should be ondemand.

2.4 Governor interface in the CPUfreq core

A new governor must register itself with the CPUfreq core using "cpufreq_register_governor." The struct cpufreq_governor, which has to be passed to that function, must contain the following values:

- **governor->name:** A unique name for this governor.
- **governor->governor:** The governor callback function is called with current (or to-be-best) cpufreq_policy struct for that cpu and unsigned event.
- **governor->owner:** THIS_MODULE for the governor module (if appropriate).

The following are the unsigned events currently defined for governor callback functions:

- **CPUFREQ_GOV_START:** This governor shall start its duty for the CPU policy->cpu.
- **CPUFREQ_GOV_STOP:** This governor shall end its duty for the CPU policy->cpu.
- **CPUFREQ_GOV_LIMITS:** The limits for CPU policy->cpu have changed to policy->min and policy->max.

NOTE: If you need other "events" externally of your driver, *only* use the cpufreq_governor_l(unsigned int cpu, unsigned int event) call to the CPUfreq core to ensure proper locking.

The CPUfreq governor may call the CPU processor driver using one of these two functions:

- int cpufreq_driver_target(struct cpufreq_policy *policy, unsigned int target_freq, unsigned int relation);
- int __cpufreq_driver_target(struct cpufreq_policy *policy, unsigned int target_freq, unsigned int relation);

EXHIBIT 1

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