Kernel driver exynos_tmu

Supported chips:

- ARM Samsung Exynos4, Exynos5 series of SoC

  Datasheet: Not publicly available

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TMU controller Description:

This driver allows to read temperature inside Samsung Exynos4/5 series of SoC.

The chip only exposes the measured 8-bit temperature code value through a register. Temperature can be taken from the temperature code. There are three equations converting from temperature to temperature code.

The three equations are:

1. Two point trimming:

   ```
   Tc = (T - 25) * (TI2 - TI1) / (85 - 25) + TI1
   ```

2. One point trimming:

   ```
   Tc = T + TI1 - 25
   ```

3. No trimming:

   ```
   Tc = T + 50
   ```

Tc:
: Temperature code, T: Temperature,

TI1:
: Trimming info for 25 degree Celsius (stored at TRIMINFO register) Temperature code measured at 25 degree Celsius which is unchanged

TI2:
: Trimming info for 85 degree Celsius (stored at TRIMINFO register) Temperature code measured at 85 degree Celsius which is unchanged

TMU(Thermal Management Unit) in Exynos4/5 generates interrupt when temperature exceeds pre-defined levels. The maximum number of configurable threshold is five. The threshold levels are defined as follows:

```
Level_0: current temperature > trigger_level_0 + threshold
Level_1: current temperature > trigger_level_1 + threshold
Level_2: current temperature > trigger_level_2 + threshold
Level_3: current temperature > trigger_level_3 + threshold
```

The threshold and each trigger_level are set through the corresponding registers.

When an interrupt occurs, this driver notify kernel thermal framework with the function exynos_report_trigger. Although an interrupt condition for level_0 can be set, it can be used to synchronize the cooling action.

TMU driver description:

The exynos thermal driver is structured as:

```
                                  Kernel Core thermal framework
                              (thermal_core.c, step_wise.c, cpufreq_cooling.c)
                                                    ^
                                                    |
                                                    |
TMU configuration data -----> TMU Driver  <----> Exynos Core thermal wrapper
(exynos_tmu_data.c)          (exynos_tmu.c)       (exynos_thermal_common.c)
(exynos_tmu_data.h)          (exynos_tmu.h)       (exynos_thermal_common.h)
```

a. TMU configuration data:
   : This consist of TMU register offsets/bitfields described through structure exynos_tmu_registers. Also several other platform data (struct exynos_tmu_platform_data) members are used to configure the TMU.

b. TMU driver:
   : This component initialises the TMU controller and sets different thresholds. It invokes core thermal implementation with the call exynos_report_trigger.

c. Exynos Core thermal wrapper:

This provides 3 wrapper function to use the Kernel core thermal framework. They are exynos_unregister_thermal, exynos_register_thermal and exynos_report_trigger.