Quiet Computing with BSD

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BSDCan 2009 — 6/9 May 2009 — Ottawa, Ontario, Canada
**AGENDA**

- Slow fans down, not speed ‘em up!
- Slower speed → less noise → less stress for the user
  - less stress → more motivation
- Desktop hardware is most popular
- Winbond Super I/O chips are ubiquitous
- Don’t reinvent the wheel — let the chip do the job
WINBOND SUPER I/O

HARDWARE MONITORS

- Several fan-controlling options:
  - Manual PWM/DC mode
  - Thermal Cruise
  - Fan Speed Cruise
  - Smart Fan III
How Do Fans Work?

- Generally, fans are rated for +12V (100% duty cycle)
- Most still run reliably at +7V (58% duty cycle)
- Few fans run at lower than +5V (42% duty cycle)
What’s PWM?

- Pulse-width modulation
- Controls the amount of power sent to a load
  - Voltage goes from high to low to high very rapidly, with a certain duty cycle
- More efficient when compared with rheostats
  (according to wikipedia)
**MANUAL MODE**

- The duty cycle is controlled through software.
- Software-based monitoring loop would be required to accommodate reduced noise and excessive heat during high-workload.
- Settings for each fan output:
  - duty cycle
  - PWM / DC and PWM frequency (if applicable)
Configure the chip to do the monitoring loop

Settings:
- target temperature and tolerance (e.g. +55°C ±2°C)
- fan start-up (e.g. 60%) and fan stop values (e.g. 40%)
- should fan be turned off completely?
- stop time / step-down time / step-up time
**Fan Speed Cruise**

- **Settings:**
  - target speed and tolerance
  - step-down time / step-up time

- But what’s the benefit vs. the Manual mode?
SMART FAN III

- An advanced self-adjusting algorithm with variable target temperature and tolerance levels
- See Winbond datasheets for details
The fan-controlling patch officially released yesterday (2009-05-08) on tech@openbsd.org

The following families of chips are supported:

- **W83627HF (PWM)**
- **W83627THF / W83637HF (manual / thermal)**
- **W83627EHF / W83627DHG (manual / thermal)**
The Hack

- Integer values passed back to individual sensors through sysctl (not *struct sensor* itselfs!)
- In the regular refresh procedure, sensor drivers check if a value has been placed, and update the chip if it has
- Chip readings are always taken from hardware
- Chip behaviour is NOT modified by this patch unless the user specifically requests so via sysctl
W83627EHF / W83627DHG

- Appear to be the latest and most popular chips
- percent\{0,1,2,3\} — summary and duty cycle
- temp\{3,4,5,6\} — target temperature
- temp\{7,8,9,10\} — temperature tolerance
- percent\{4,5,6,7\} and \{8,9,10,11\} — Start-up and Stop
- indicator\{0,1,2,3\} — PWM/DC mode switch
hw.sensors.cpu0.temp0=58.00 degC
hw.sensors.lm1.temp0=45.00 degC (Sys)
hw.sensors.lm1.temp1=51.00 degC (CPU)
hw.sensors.lm1.temp2=14.50 degC (Aux)
hw.sensors.lm1.temp3=38.00 degC (Sys Target)
hw.sensors.lm1.temp4=unknown (CPU Target)
hw.sensors.lm1.temp5=unknown (Aux Target)
hw.sensors.lm1.temp6=unknown (CPU Target)
hw.sensors.lm1.temp7=2.00 degC (Sys Tolerance)
hw.sensors.lm1.temp8=unknown (CPU Tolerance)
hw.sensors.lm1.temp9=unknown (Aux Tolerance)
hw.sensors.lm1.temp10=unknown (CPU Tolerance)
hw.sensors.lm1.fan0=1854 RPM (Sys)
hw.sensors.lm1.volt0=1.34 VDC (VCore)
hw.sensors.lm1.volt1=12.20 VDC (+12V)
hw.sensors.lm1.volt2=3.33 VDC (+3.3V)
hw.sensors.lm1.volt3=3.33 VDC (+3.3V)
hw.sensors.lm1.volt4=-3.95 VDC (-12V)
hw.sensors.lm1.volt5=0.11 VDC
hw.sensors.lm1.volt6=1.62 VDC
hw.sensors.lm1.volt7=3.28 VDC (3.3VSB)
hw.sensors.lm1.volt8=0.03 VDC (VBAT)
hw.sensors.lm1.indicator0=Off (Sys Fan PWM/DC: PWM)
hw.sensors.lm1.indicator1=Off (CPU Fan PWM/DC: PWM)
hw.sensors.lm1.indicator2=Off (Aux Fan PWM/DC: PWM)
hw.sensors.lm1.indicator3=On (CPU Fan PWM/DC: DC)
hw.sensors.lm1.percent0=100.00% (Sys Fan PWM Thermal), OK
hw.sensors.lm1.percent1=100.00% (CPU Fan PWM Manual), OK
hw.sensors.lm1.percent2=100.00% (Aux Fan PWM Manual), OK
hw.sensors.lm1.percent3=100.00% (CPU Fan DC SmartIII), OK
hw.sensors.lm1.percent4=0.39% (Sys Fan Start-up Value), CRITICAL
hw.sensors.lm1.percent5=unknown (CPU Fan Start-up Value)
hw.sensors.lm1.percent6=unknown (Aux Fan Start-up Value)
hw.sensors.lm1.percent7=unknown (CPU Fan Start-up Value)
hw.sensors.lm1.percent8=29.41% (Sys Fan Stop Value), CRITICAL
hw.sensors.lm1.percent9=unknown (CPU Fan Stop Value)
hw.sensors.lm1.percent10=unknown (Aux Fan Stop Value)
hw.sensors.lm1.percent11=unknown (CPU Fan Stop Value)
Chips are terribly miswired by MB manufacturers

Often all fans are controlled by a single source

Sometimes fans cannot be controlled at all

Theoretically, this stuff can cause bad interactions with BIOS/ACPI/etc; in practice, it tends to work on desktop hardware without noticeable issues

Some BIOSes have an annoying ‘fan error’ message
Live Demonstration!
Questions?
Comments?

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