Power State Monitoring and Energy Consumption Monitoring

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Power Management

- we need means for power management
  - rising energy cost
  - increased awareness of ecological impact of running IT and NW equipment
- basic objective
  - run networks and attached equipment with minimal amount of energy
- use power saving modes
  - reduced power, stand-by, power off
- define policies for dealing with trade trade-offs
  - energy efficiency vs. service level objectives

Essential First Step: Power Monitoring

- **monitoring does not directly save energy**
  - it rather consumes additional energy

- **however, it is needed for**
  - investigating power saving potential
  - deriving, implementing, testing and evaluating energy saving policies and measures
  - input to control loop for dynamic power management
  - accounting the total power consumption of a network element, a network, a service, ...

General Monitoring Requirements

- target devices
  - all components of a communication network: routers, switches, middleboxes, hosts, etc.

- granularity
  - also components of devices: CPU, ASICS, fans, hard drives, line cards, etc.
  - higher granularity for power state monitoring than for actual energy consumption monitoring
    - cost of instrumentation

- remote and aggregated monitoring
  - single device may provide information for several others
  - examples: PoE switch, smart meter

Required Information: Power State

- pull-based power state monitoring
  - current state
    - full power, low power, standby, hibernating, off
  - cause for the last transition
  - time to transit from one stage to another
  - total time spent in each state
  - duration of the last period spent in each state
  - number of transitions to each state
  - current power source
  - ...
- notifications on power state changes

Required Info: Energy Consumption

- energy consumption monitoring
  - current real power (energy consumption rate) averaged over a short time interval
  - peak values
  - total energy consumption
  - energy consumption since the last report or for the last configured time interval
  - total energy consumption per power state
  - energy consumption per power state since the last report ...
  - ...
- pull AND push model reporting may be required

Battery Monitoring

- current charge of battery

- age of battery

- state of battery (e.g. being re-charged)

- last usage of battery

- maximum energy provided by the battery

- ...

Meta Information

- accuracy of meter

- AC or DC

- power measurement interval

- real or apparent power

- reporting interval

- ...

Monitoring Models

- ## pull model
  - ◆ obviously needed

- ## push model: notifications
  - ◆ notifications for power state changes
  - ◆ notifications for exceeding power thresholds
  - ◆ notifications on battery status

- ## push model: continuous reporting
  - ◆ smart meter

Existing Standards

- RFC 4268 (Entity State MIB)
    - standby status (hot, cold, providing service)
- RFC 3433 (Entity Sensor MIB)
    - generic, can be used for power monitoring
- RFC 3621 (Power Ethernet MIB)
    - good information on small devices powered with PoE
    - accessible at power sourcing equipment
- RFC 1628 (UPS MIB)
    - good information for UPS protected devices
- DMTF power state management profile
    - targeted at hosts, using Common Information Model (CIM)
    - rather device profile than actual monitoring
- IEEE 1621 "Power Control User Interfaces"
    - support from the editor for the IETF activity
- ETSI ES 202 336
    - Environmental Engineering (EE): Power and cooling system control and monitoring guidance
- and much more ... further input is appreciated

Suggested Actions

- define Power MIB module as extension of existing RFCs
  - we have standards for collecting basic information on power state and source
  - we don't have them for statistics and accumulated values
- select a protocol for push-based reporting of time series of energy measurements
  - candidates: SYSLOG, IPFIX, ...
- define structured data / information elements for transmitting energy measurement data
- still the first step: collect further input
  - on requirements
  - on existing standards and ongoing standardization
- further contributors are very welcome !

Questions

- Shall we include smart meters at home in our scope?

- Shouldn't we start caring about other components of energy management?
    - configuration, scheduling, control, ...