Power Aware Packet Processing

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Why we are here

- Drive for data and always on networks

- Opportunity for Green DPDK
  - Based on continued polling and varying traffic rates

- Achieve electricity cost saving & Increase Performance

- Proposed Updates to the existing Power Management scheme
Mapping Power Usage to Network Traffic

For Illustration Purposes Only

Energy Saving Opportunity
Potential to be in scaled down state

Expected or Unexpected Burst Handling

System % Busy

Example 24-hour period

Network Traffic
Meeting the needs of an on demand network

- Scale always on DPDK performance with the network demand
- Common Challenges
  - Always On
    - Adjust PMD cores frequency to adjust to packet demand
    - Potential to save power drawn per core using frequency scaling
      - ++ from sleeping
  
- Speed of Re(Action)
  - Challenge: Fast Scale Up to react to increases in n/w traffic
  - Time = queueing/buffering
  
- Challenge: Fast Monitor & Reaction Time
  - Closer to hardware gives faster reaction time

- Move to Policy based control

Apply Power Where and When it’s needed
Design Considerations

- Ability to scale up quickly e.g. burst detection

- Dimension queue depth and monitoring for worst case or maximum latency

- Dimension receive descriptors in the DPDK poll mode driver, to handle bursts

- Example: 128 default size/depth holds ~8us

- Depth of queues related to energy efficient & performance technology state changes
  - Identifying modules with shallow queueing, to avoid packet loss
Opportunity for Energy Efficiency & Performance

- Expect energy headroom to be available in most scenarios

- Varying frequency can save energy

- For example Intel® Xeon™ Scalable Processor 8180 frequency variation per core allowed from 1200MHz to 2500MHz (without Turbo)

- Impactful power saving on 1200MHz vs 2500MHz

- Further savings possible with additional technology tuning
  - For example, varying core activity / sleep states
In-band Policy Control for Power Mgmt

- Patch Set for 17.11
- Power Governor on host
- Takes profiles from Guest
- Scale up/down based on:
  - Traffic Rates
  - Time of Day
  - Workload (next)
- Match compute to network/CPU load

**Diagram Description**

- **DPDK application with librte_power (guest)**
  - GUEST 0
  - NIC VF
  - VCPU0
  - VCPU1

- **DPDK application with librte_power (guest)**
  - GUEST 1
  - VCPU0
  - VCPU1
  - VCPU2
  - NIC VF

- **HOST**
  - VM Power Monitor with librte_power (host)
  - virtio-serial channel

- **Linux Power Governor**
  - CPU0
  - CPU1
  - CPU2
  - CPU3
  - CPU4
  - CPU5
  - CPU6
  - CPU7

- **NIC**
  - NIC PF
  - NIC
- Enable Turbo: Enable Intel® Turbo Boost Technology on the specific lcore
  - Core frequency will go to whatever frequency is allowed for that core based on number of active cores on the packet, thermal limits, etc.

- Disable Turbo: Disable Intel® Turbo Boost Technology on the specific lcore
  - Core frequency will return to the maximum non-turbo frequency, if lower freq required, a further library call is required to scale down, go to minimum, etc.
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Questions?

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