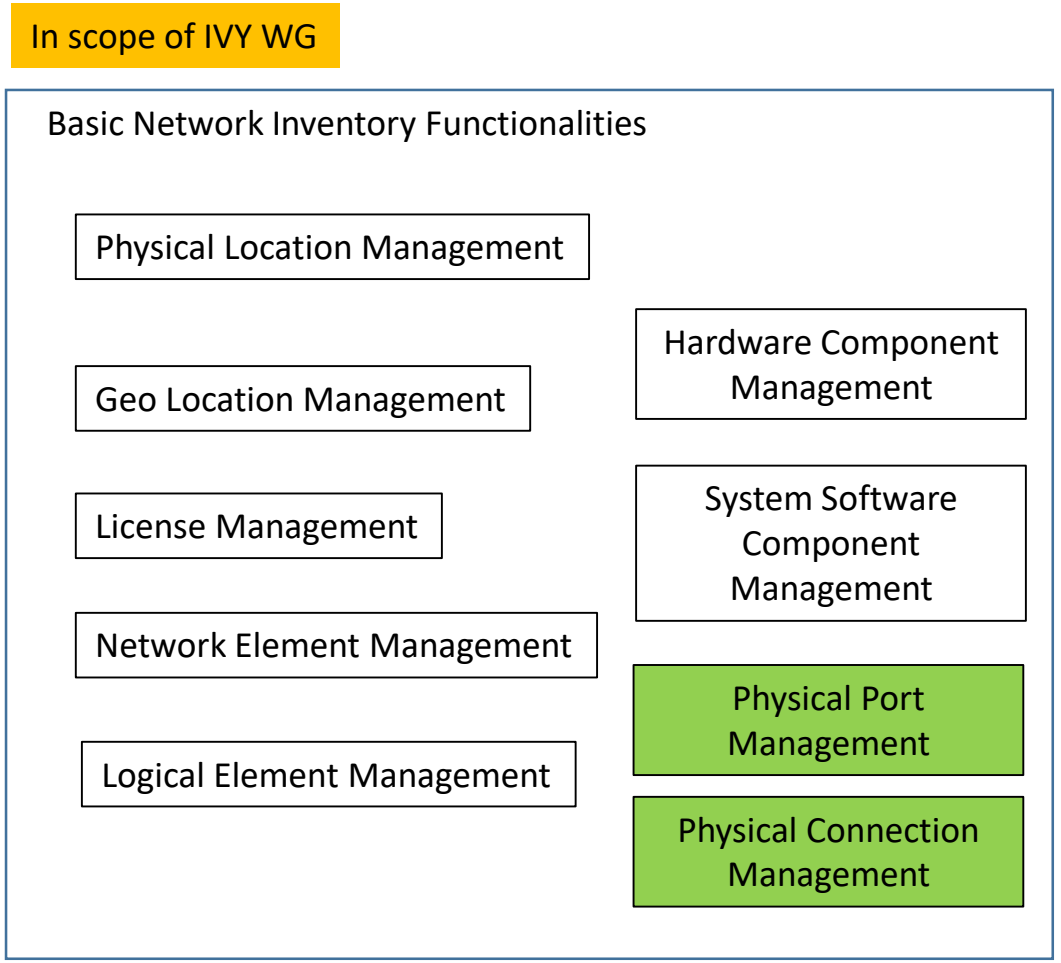
The Network Inventory for Energy Management

Qin Wu Huawei (bill.wu@Huawei.com)

Motivation

- IVY WG has recently been formed in IETF OPS area.
- IVY WG is tasked to define core network inventory model that includes both hardware and software inventory data and can be used a foundation by other model to establish inventory model specific to different hardware technology.
- Many vendors equipment offers energy saving functionalities in their hardware component such as
  - Making some of port going into idle mode by tuning off SerDes and additional electronic circuits;
  - Warm Back up to make chipset enter into energy saving mode



Motivation

- Network energy consumption accounts for 85% of operators' total energy consumption
  - Wireless: 40~60%，Base Station: 75%, Core Site: 20%, Data Center: 20%~25%, Broadband access: 15%~20%, etc
- The global MBB traffic is increased 10 times in last 10 years, The number of **sites increases by 30%** and the **frequency band increases by 3 times**. Power consumption increases by 3.65 times.

Energy Management using Heat Map Use case

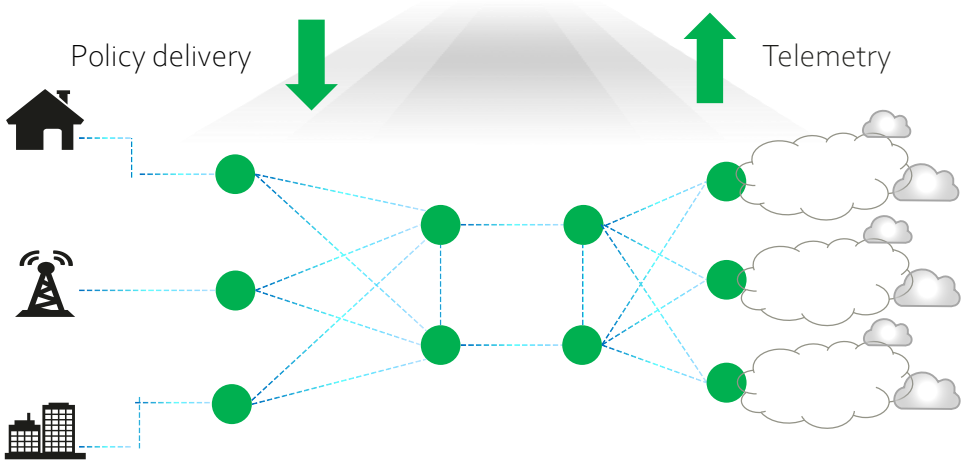
Management System

Energy Efficiency Management

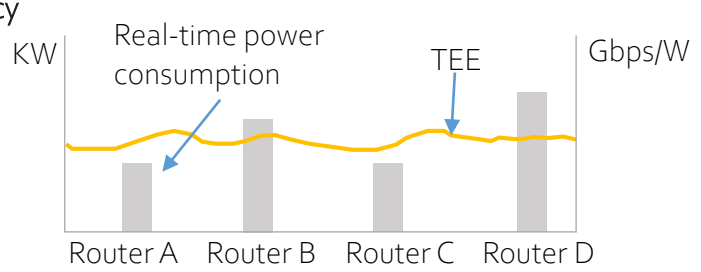
Energy Policy Mgmt.

Visualized Energy Efficiency

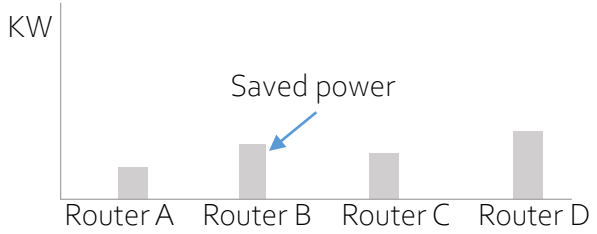
Energy Saving Evaluation



Visualized Energy Efficiency



Energy Saving Evaluation



Energy Policy Management

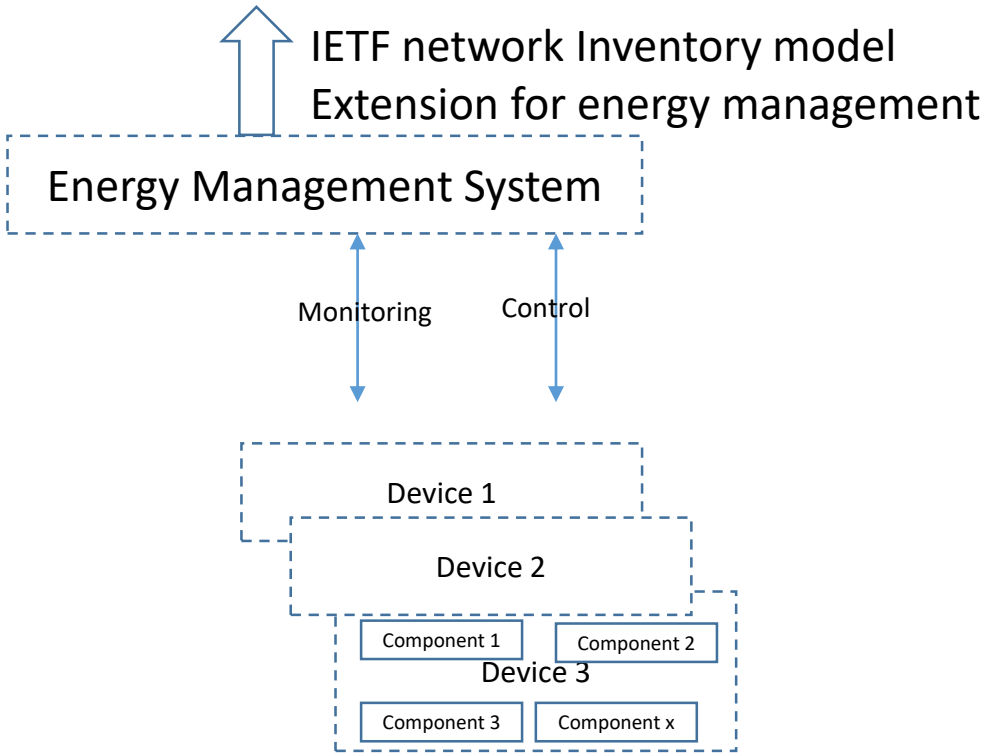
Device	Energy saving switch
Router A	
Router B	
Router C	

Energy Heat Map Distribution
Across routers in specific region

Design Consideration

- Design Consideration for extending Core network inventory for energy management
  - Where to Monitor
    - A network device consists of a lot of individual component, each of component consumes power
    - Based on [I-D.manral-bmwg-power-usage], the location of monitors related to network inventory includes
      - Chassis, linecard, port, TCAM, Firmware , etc
    - The external component should also be counted such as Fan, external memory, HAVC, etc
  - What to Monitor :Network Inventory related Metrics include
    - Device Level: factors include base chassis power, number of line cards, active ports, port settings, port utilisation, TCAM size, firmware version, etc
      - Metric can be power consumption per chassis, per linecard, per port
    - Network Level: The metrics can be
      - Total energy consumption
      - Electricity from renewable sources (%)
      - Network energy efficiency (MWh/PB)
  - How to Measure and Report
    - Hardware YANG model [RFC8348] or ENTITY-SENSOR-MIB object defined in [RFC3433] can be used to collect energy consumption metric but not state
    - MIB for monitoring for Power State and energy consumption of networked [RFC7460] unable to collect energy consumption for each hardware component.
  - How to Control
  - The hardware component might have energy adjust function and indicate it to the management
    - Port has port setting allow the management system to limit line rate forwarding capacity of individual ports
    - TCAM size can be tuned to change power consumption, but not significantly
    - Change the number of active port, make some of port going into idle mode by tuning off SerDes and additional electronic circuits
      - Serdes Waking up time is the key
    - Network Processor adaptive adjust based on traffic monitoring
    - Warm Back up to make chipset enter into energy saving mode

Next Step



- Do we need a new monitoring standard for Green Power consumption measurement report?
  - Both YANG module defined in [RFC8348] and ENTITY-SENSOR-MIB object defined in [RFC3433] has its limitation
  - MIB for Power and Energy [RFC7460] can not provide component level energy monitoring
- Extend IETF network Inventory model with energy management Support? Any volunteer to work together
  - IVY work on basic network inventory model
  - Energy management is the missing piece