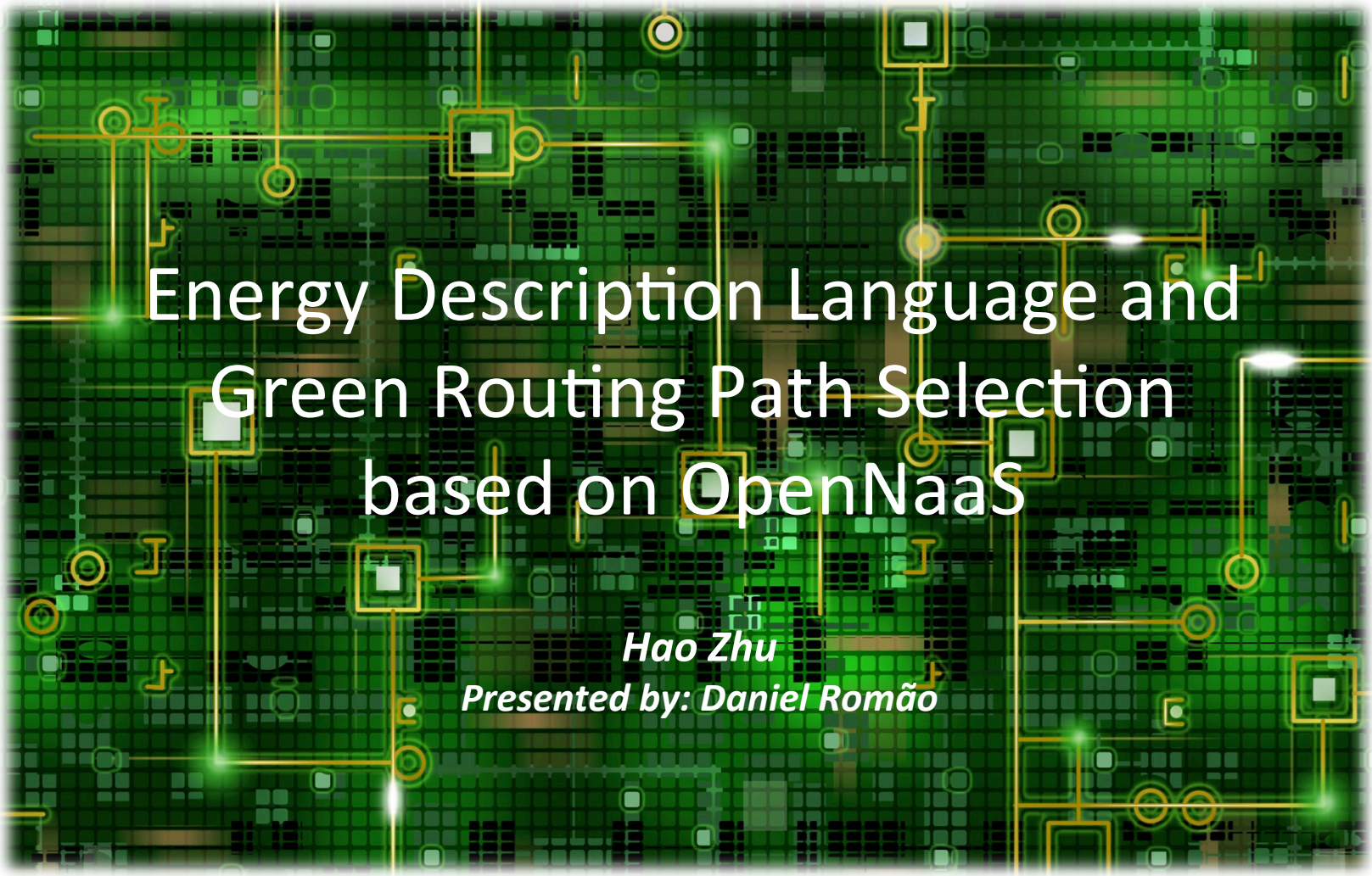
System and Network Engineering



Energy Description Language and Green Routing Path Selection based on OpenNaaS

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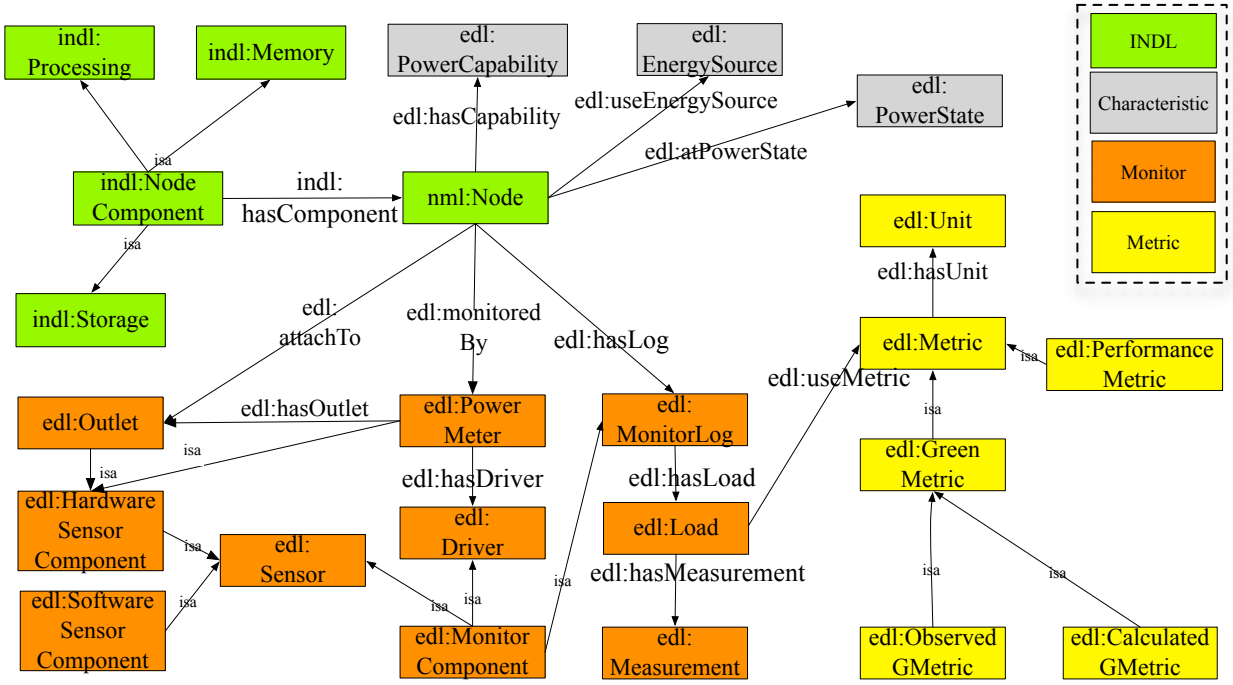
Motivation

- ICT: CO2 emission 2%; 10% for developed countries
- Power consumption of network is sharply rising
- Therefore, save energy in networks can
  - Weaken the effect on global warming
  - Cut infrastructure providers' operation expenditure
- How save energy in networks?
  1. Understand and monitor energy info of network resources
  2. Energy management in a network management platform e.g. OpenNaaS

Info model: Energy Description Language

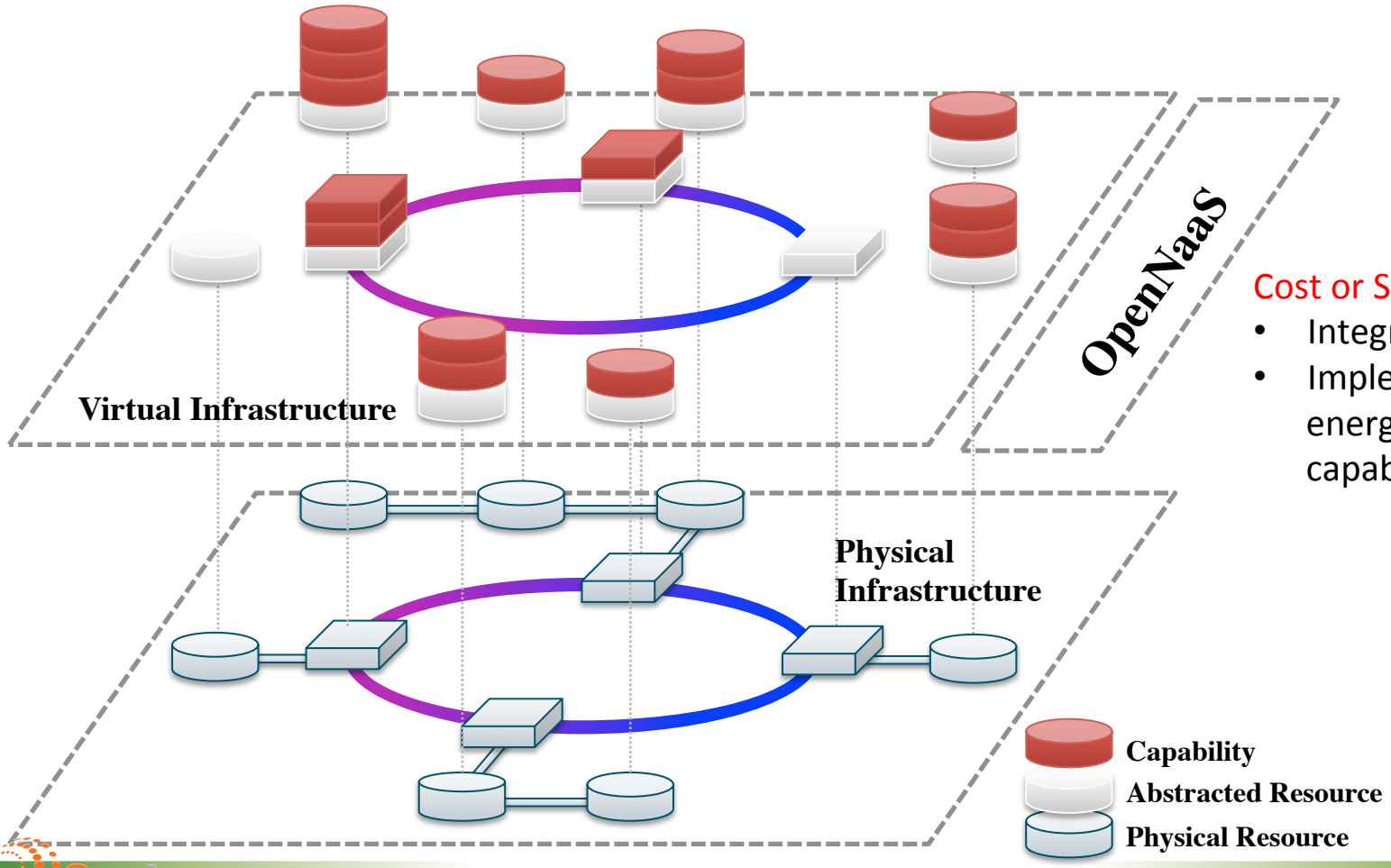
- Energy management policies in networks depend on topology, energy and workload information, which EDL can describe.
- Energy-aware infrastructure and network Description
  - Semantic web based info model
  - Concepts of energy, network and computing infrastructure



Integrate energy-aware capabilities in OpenNaaS

OpenNaaS is a platform for provisioning network resources

- Allow deployment and automated configuration of dynamic network infrastructures
- Define a vendor-independent interface to access services provided by these resources.



Cost or Sustainability?

- Integrate EDL;
- Implement energy-aware capabilities

Energy-aware capabilities in OpenNaaS

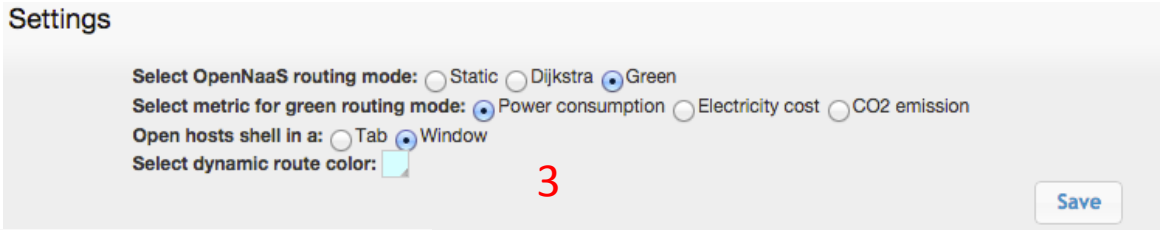
- Green network capabilities use EDL as info model:
  1. Energy description capability: create and manage info about
     - Energy source
     - Power meters
     - Green metric
     - Power state etc.
  2. Energy monitoring capability: obtain data in
     - Observed metrics:
       - Power, energy, CO2 emission rate, electricity price
     - Calculated metrics:
       - Total Electricity, CO2 emission, energy efficiency
  3. Green routing capability
     - in terms of power, cost and emission metrics

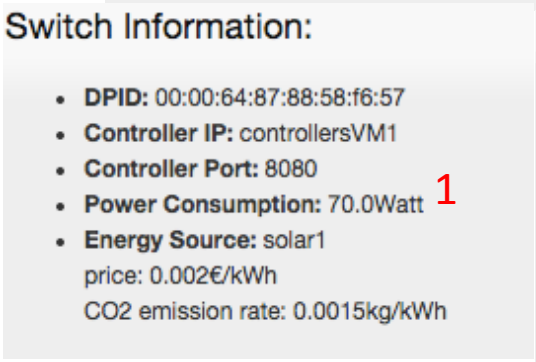
Benefits of energy-aware capabilities in OpenNaaS

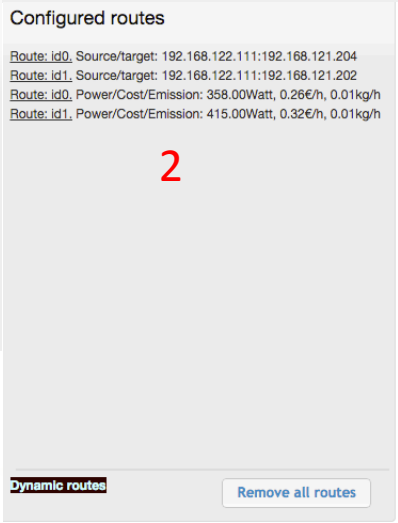
- For both end users and network providers e.g. GEANT, NERNs
  - Understand energy, cost and sustainability info of network resources
- For users
  - Support the request of resources or networks on green demand
- For providers
  - Offer green resources or networks when meeting the performance demand of users
  - Select a green routing path for a flow request of users who are not sensitive to network performance

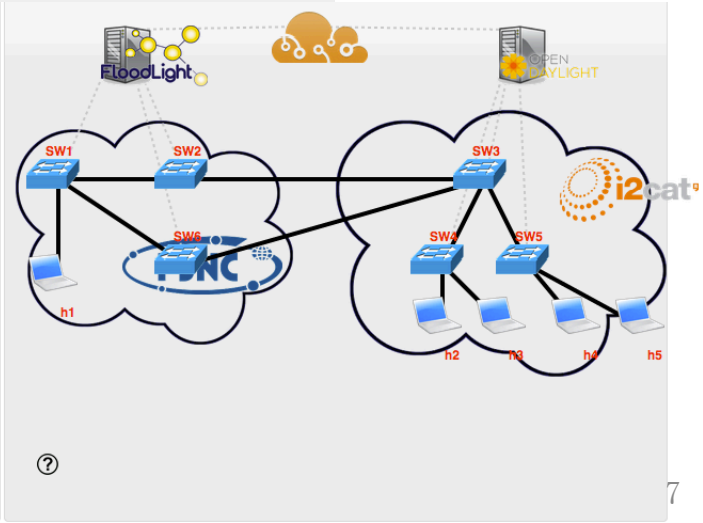
Green routing demo based on OpenNaaS

- Three functions of green routing demo
  1. Show power in info of each node
  2. Show power info of each specified routing path
  3. Find green routing path using three green metrics
     - Power consumption is stable for today's network devices
     - Calculate a static routing path for specified starting and destination nodes









Future work: Green routing based on OpenNaaS

- Complicated case:

power consumption relies on bandwidth usage for EEE-enabled devices:

  - Need more input : topology and power model as well as workload info
  - Output: routing path and bandwidth utilization

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