

OPSAWG@IETF114, Philadelphia, PA  
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# Management and Operations for Green Networking

Green Networking Metrics

<https://datatracker.ietf.org/doc/html/draft-cx-green-metrics-00>

Alex Clemm, Lijun Dong, Greg Mirsky, Laurent Ciavaglia, Jeff Tantsura, Marie-Paule Odi

Challenges and Opportunities in Green Networking

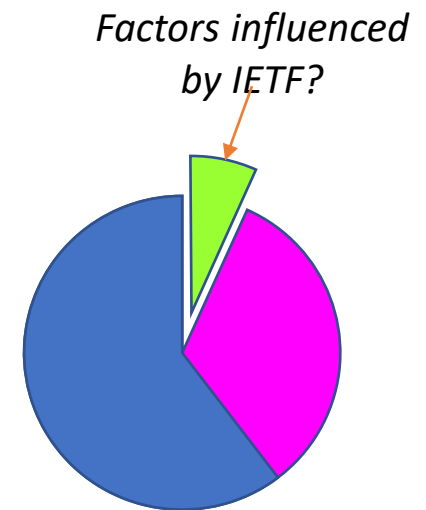
<https://datatracker.ietf.org/doc/html/draft-cx-green-ps-00>

Alex Clemm, Cedric Westphal, Jeff Tantsura, Laurent Ciavaglia, Marie-Paule Odi

*Point of contact: Alex Clemm [ludwig@clemm.org](mailto:ludwig@clemm.org)*

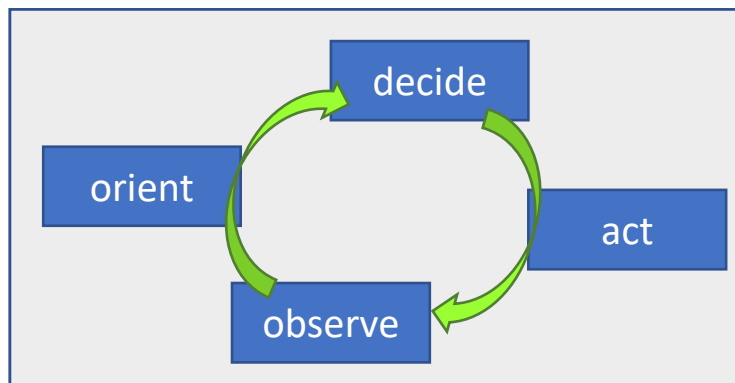
# Why Green Networking?

- Reducing carbon footprint to “Net Zero” is one of mankind’s “grand challenges”
- Networking applications are a key enabler in this, but is this enough?
  - Substantial footprint enabler for a lot of “green” already
  - But, networks consume lots of energy themselves
  - Net Zero mandates will apply to network providers as well
- Key contributors to network energy efficiency today
  - General hardware advances (e.g. Moore’s law – but slowing)
  - Deployment factors (e.g. Nordic locations for datacenters)
  - Antenna technology
- What about network- and management-specific factors?
  - What are ways in which the IETF can contribute?
  - Even if just a small slice of the pie, everything counts...



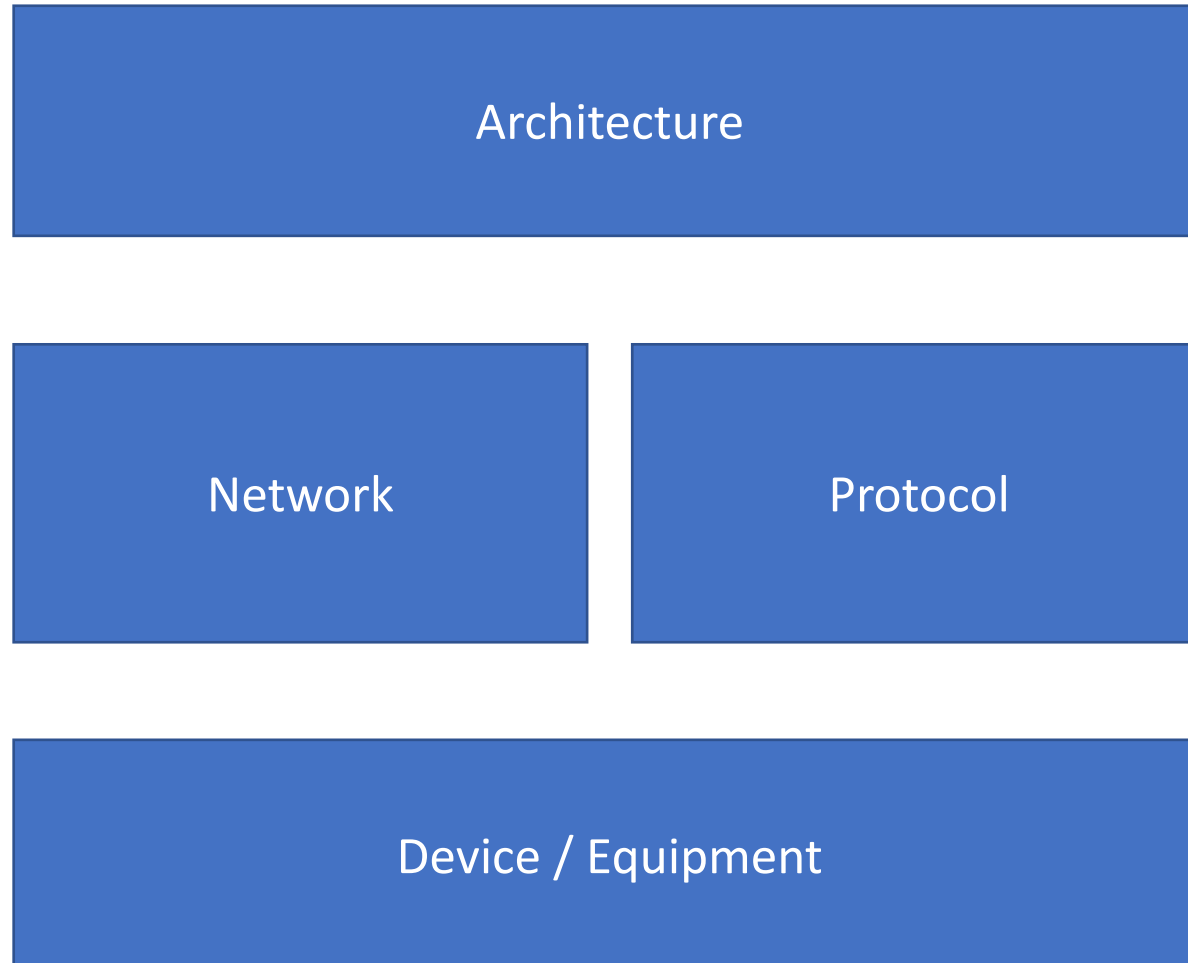
# Operations a big part of the equation

- Deployment and network optimization
  - Energy usage is a great parameter to optimize, just like utilization, cost, etc
  - VM+VNF placement
  - Planning of routes, segments, paths
  - Moderating tradeoffs: resource consumption versus service levels, utilization versus service levels, caching versus access, etc
- Management involves control loops
  - Visibility as the common enabler for many “green” opportunities
  - Very short time scales may be required as data transmission fluctuates wildly



# Structuring the opportunity space

draft-cx-green-ps (Alex Clemm, Cedric Westphal, Jeff Tantsura, Laurent Ciavaglia, Marie-Paule Odi)



# Device / equipment level

- Important but mostly outside IETF scope
  - Power-efficient hardware, less heat dissipation
  - Eco-friendly materials, easy recycling at end of life cycle
  - Reduce energy usage of transmission technology (lasers, antennas)
- Getting closer
  - Control knobs to configure energy-saving policies  
(power saving modes common in endpoints, what about equipment)
- Of specific interest here: provide visibility into current energy usage
  - Assess actual efficiency
  - Enable control loops for energy optimization schemes
  - Requires instrumentation for energy metrics

# Protocol / network / architecture level

- Protocols:
  - Enabling network energy saving mechanisms
    - Fast discovery, fast state reconvergence to accommodate more rapid power cycles
    - Role of autonomies? of IBN?
  - Network addressing and deployment (e.g. smaller tables to maintain)
  - Data volume reduction (e.g. mgmt. of codings, efficient retransmission schemes)
- Network:
  - Energy-related control protocol extensions – e.g. energy as a cost factor in IGP, in SDN controllers
  - Energy-aware routing & path configuration – assess carbon intensity, steer traffic along “greener” paths
  - Resource weaning schemes – turn resources on/off while mitigating other operational goals
  - Deployment / placement of VNFs
  - Green abstractions, taking into account memory, processing, and transmission
- Architecture level
  - Facilitate organization of applications to minimize energy consumption
  - Examples: content retrieval, compute placement (compare CDN/ICN/COIN but from energy perspective)

# Network energy metrics

draft-cx-green-metrics (Alex Clemm, Lijun Dong, Greg Mirsky, Laurent Ciavaglia, Jeff Tantsura, Marie-Paule Odini)

- Enabler for “green” management: visibility
  - Peter Drucker: “You cannot manage what you cannot measure” (or observe)
  - This requires instrumentation, which requires metrics
- Related to equipment
  - Power consumption when idle, at various loads (50,90,99%)
  - Current consumption, consumption since last start, absolute vs normalized (relative to traffic), etc
  - Think “YANG modules” (not part of the draft)
- Related to flows
  - Incremental and amortized energy over flow duration, at a device, across the flow, etc
- Related to paths
  - Path energy ratings, etc
- Related to network-at-large
  - Total energy consumption (MWh), network energy efficiency (MWh/PB)
  - Aggregates by which network providers are “measured”, to be optimized

# Next steps

- Raise awareness & gain critical mass as a topic
- Two drafts on this topic have been posted as a starting point
  - Problem statement (Challenges and Opportunities)
  - Metrics (as a first specific work item)
  - Actually, three: draft-eckert-ietf-and-energy-overview
  - **Much** more (including more drafts) will be needed
- Looking for collaborators (and landing spot)
  - Challenges/opportunities: may be a candidate for IRTF→NMRG (?)
  - Green Networking Metrics → OPSAWG (?)
  - Other topics TBD
- Comments? Questions? Please contact us
  - [draft-cx-green-ps@ietf.org](mailto:draft-cx-green-ps@ietf.org)
  - [draft-cx-green-metrics@ietf.org](mailto:draft-cx-green-metrics@ietf.org)

**THANK YOU!**