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Side Meeting on Environmental Impact

Green Networking Metrics

https://datatracker.ietf.org/doc/html/draft-cx-green-metrics-02

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** joining from -03*

Why Green Networking Metrics

- Reducing carbon footprint to “Net Zero” is one of mankind’s “grand challenges”
- This challenge also extends to network technology
- Recent IETF activities:
  - IAB Workshop on Environmental Impact of Internet Applications and Systems (Dec 2022)
  - Various drafts (including Green Networking Problems and Challenges – draft-cx-green-ps)
- Visibility and instrumentation recognized as important building block
  - How else to assess how you are doing?
  - Enabler for other solutions that optimize, minimize carbon footprint
- This starts with defining the right metrics → this draft
  - Positioned in opsawg which is receptive to adoption
- Not covered in this draft (left for future work)
  - Definition of data models
  - Methods for measurement or instrumentation

Metrics space

Equipment/ Device	Attribute carbon footprint to the “root” Main focus on energy consumption, energy utilization efficiency Considerations for energy sources Sustainability factors, modifiers (e.g. adjust for energy mix) Conversion factors between “power” and “carbon” (2nd order functions) Virtualization considerations: virtual energy, virtual footprint Attributing carbon footprint incurred by hosting infrastructure to VNFs, etc Examples Power consumption absolute / normalized, per chassis/line card/port, etc Consumption ratings (datasheet stuff) Sustainability ratings and factors

Metrics space (contd.)

Flows	Relate carbon footprint to flows and service instances Function of volume and duration Additional considerations for packet replication, loss, etc. Carbon flow statistics, enable carbon-based accounting Examples: Energy consumption / carbon footprint over duration of flow
Paths	Assess carbon intensity of paths and route alternatives Energy-/ Carbon-/ Pollution-Aware Networking Examples: Path energy/carbon ratings (function of carbon ratings of hops)
Network-at-large	Totality of the picture aggregated across network-at-large Examples: Total energy consumption (MWh), Network energy efficiency (MWh/PB)

Additional considerations

- Holistic Perspective: energy consumption versus other factors
  - Energy consumed ≠ carbon footprint
    - Account for energy sources (windmill vs Diesel generator)
      Specific sources not always known but may assign factors based on energy mix
    - Apply conversion formulas power vs carbon
  - Accounting for “other stuff”: HVAC, for hidden devices
    - Can apply additional sustainability factors as a “tax”
  - Sustainability of equipment itself: accounting for inherent carbon within the device
    - More factors: account for energy for production, amortized over device lifecycle, adjusted for recyclability, etc.
  - Maintain base energy consumption metrics and adjustment factors separately
    - Apply factors as secondary metrics (e.g. MWh/PB → Carbon kg / PB → deployment weighed carbon kg / PB)
- Certification
  - Trustability of energy / carbon ratings (specifically but not only for equipment metrics)
- Dealing with imprecision and uncertainty
  - Specify ranges vs absolute values in some cases (e.g. power consumption of links)

THANK YOU!