

Export of Energy Consumption Information in IPFIX

draft-yan-opsawg-ipfix-energy-consumption-01

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BACKGROUND

Global Drivers

- Energy consumption has become a critical operational metric in modern data centers and networks, driven by:
 - **sustainability requirements**
 - **cost efficiency demands**
 - **regulatory compliance**

Operator Needs

- Network operators need accurate, traffic-correlated power information to support:
 - **energy-aware routing decisions**
 - **per-service energy cost accounting**
 - **fine-grained power optimization.**

THE GAP: EXISTING PROTOCOLS

Current protocols (SNMP, NETCONF) rely on **periodic polling**



Critical Flaw: Loss of causality between traffic events & energy consumption



Impact: Delayed insights, unable to correlate power spikes with traffic bursts

MOTIVATION: WHY IPFIX?

✘ Limitations of Existing Approaches

SNMP & NETCONF

Request-response model with **fixed polling intervals**.

Cannot establish causal binding between traffic events and power consumption.

YANG Push

Still fail to track traffic-induced power changes.
Data sampling is decoupled from data plane load dynamics.

✔ IPFIX Advantages

Event-Driven

Binds metering directly to traffic events.
Ensures **timely and causal** reporting.

Traffic-Correlated

Triggered by **packet counts** or **active/inactive timeouts**

Extensible

Easy to add new Information Elements without protocol stack changes.

Core Insight: IPFIX's event-driven architecture is naturally suited for traffic-correlated energy telemetry.

OVERVIEW

📄 Core Proposal

Defines **six new IPFIX Information Elements** to export energy consumption for physical entities in network devices.

📄 Granularity & Metrics

Three levels: **Device, Line Card, Port**.

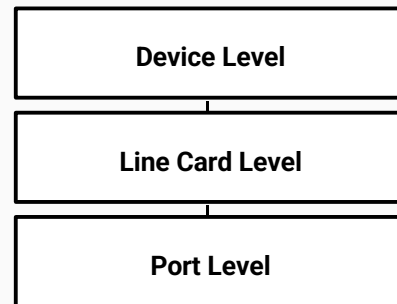
Two types: **Realtime** (instantaneous) & **Average** (interval-based).

⚡ Key Characteristic

Traffic-driven export preserves causality between traffic events and energy consumption.

🎯 Target Applications

Energy-aware routing, per-flow energy auditing, and fine-grained power management.



NEW INFORMATION ELEMENTS

LEVEL	REALTIME (INSTANTANEOUS)	AVERAGE (INTERVAL)
Device	deviceRealtimePower	deviceAveragePower
Line Card	lineCardRealtimePower	lineCardAveragePower
Port	portRealtimePower	portAveragePower

EXPORT TRIGGERS

Packet Count

Export when N packets are processed.

⌘ Active Timeout

Periodic export for sustained low-rate traffic

⌘ Inactive Timeout

Export when flow ends.

USE CASE 1: ENERGY-AWARE ROUTING

🎯 THE GOAL

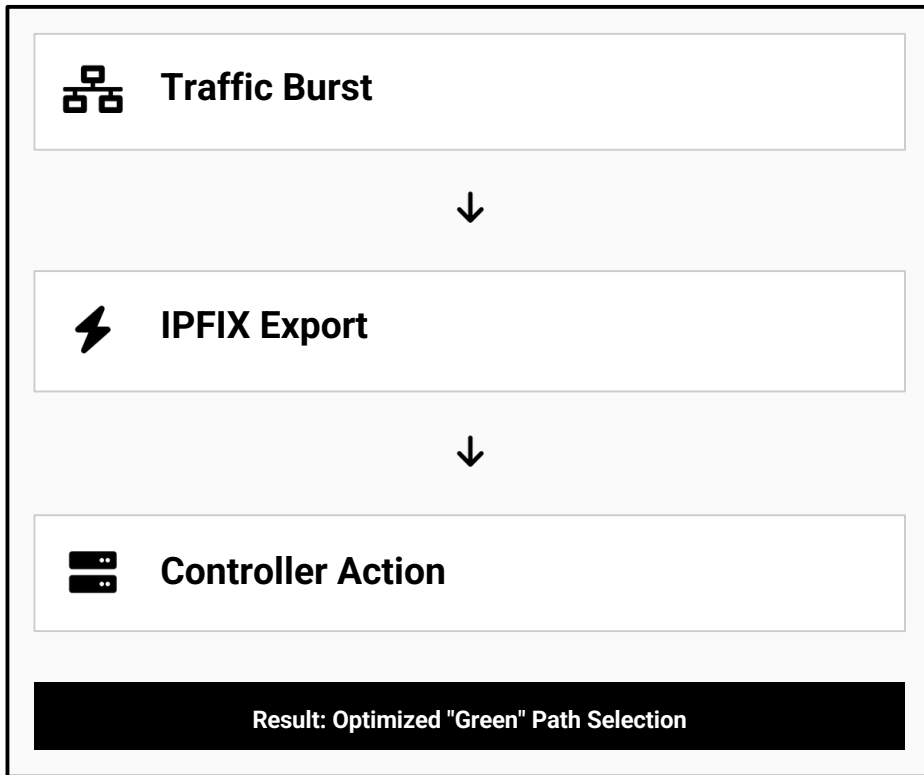
Compute network paths that minimize **total energy cost**, not just latency or bandwidth.

⚠️ THE PROBLEM

Traditional metrics are poor proxies for power. Polling is too slow to capture the **power spikes** caused by micro-bursts.

✅ THE SOLUTION

Export RealtimePower triggered by traffic thresholds. This provides instantaneous power draw data directly correlated with specific traffic loads.



USE CASE 2: PER-FLOW ENERGY AUDITING

🎯 THE GOAL

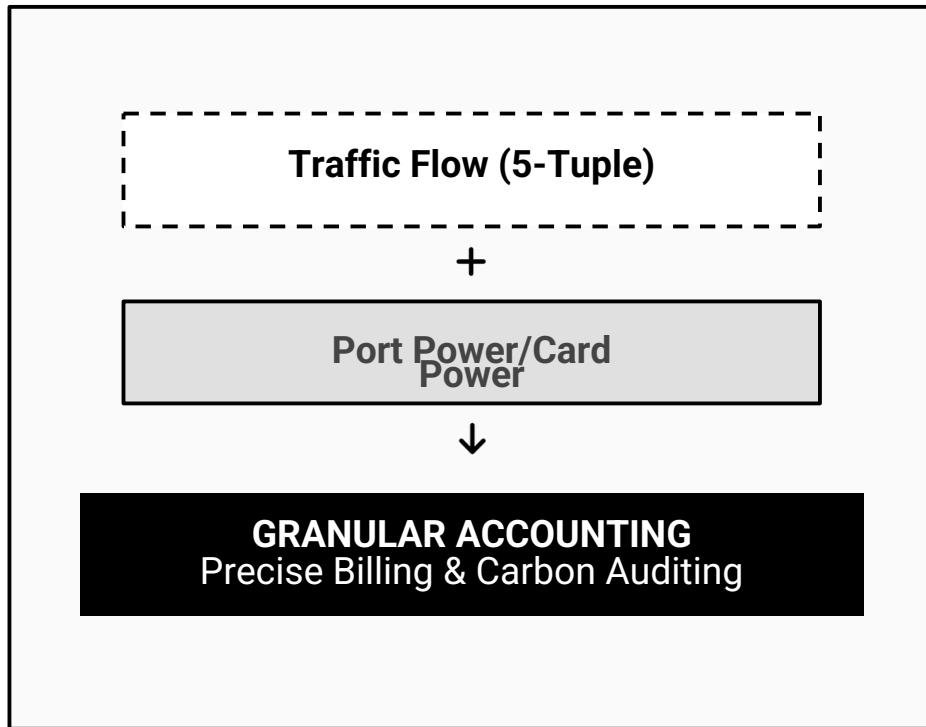
Attribute energy costs to specific **services** or **customers**

⚠️ THE PROBLEM

"Elephant flows" consume significant resources across multiple components, but traditional metering is only device-wide.

✅ THE SOLUTION

Correlate **5-tuple flow keys** with **linecard** and **port energy IEs**. Synchronized export ensures data alignment.



KEY INNOVATIONS

Traffic-Aware Collection

MECHANISM

Uses traffic events as the core triggering mechanism.

BENEFIT

Solves the asynchronous collection problem of polling; enables precise causal attribution.

Composite Templates

MECHANISM

Combines multi-level energy IEs (Device, Card, Port) with their identifiers.

BENEFIT

Synchronized collection of all relevant energy data in a single export event.

TECHNICAL BREAKTHROUGH

Bridges the gap between IPFIX's event-driven capabilities and physical-layer telemetry, creating a standardized mechanism for traffic-correlated energy monitoring.

Thank You

Questions and feedback are welcome



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