Energy Efficiency Routing

draft-li-lsr-flex-algo-energy-efficiency-00

draft-liu-spring-sr-policy-energy-efficiency-00

draft-liu-idr-bgp-ls-energy-efficiency-00

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IETF 123

Background

The increasing energy consumption of the Internet has led more and more operators to pay attention to the energy consumption management of communication systems and pursue higher energy efficiency.

GREEN WG Scope:

- Collecting and updating requirements for the management of energy-efficient networks.
- Defining use cases for managing energy-efficient networks.
- Defining terms and definitions related to energy efficiency metrics. Where possible, terms and definitions in existing RFCs will be reused.
- Developing YANG models to enable measuring and reporting of energy usage through metrics and attributes at component, device, and network levels.
- Providing YANG models to allow operators to optimize energy usage in network components, devices, and across the network, via configurable energy efficiency capabilities.
- Developing or selecting a framework for energy efficiency monitoring, energy efficiency capability discovery, and management within a network domain.

Out of Scope:

- Routing protocols and algorithms, including those that consider energy factors.

Mechanism

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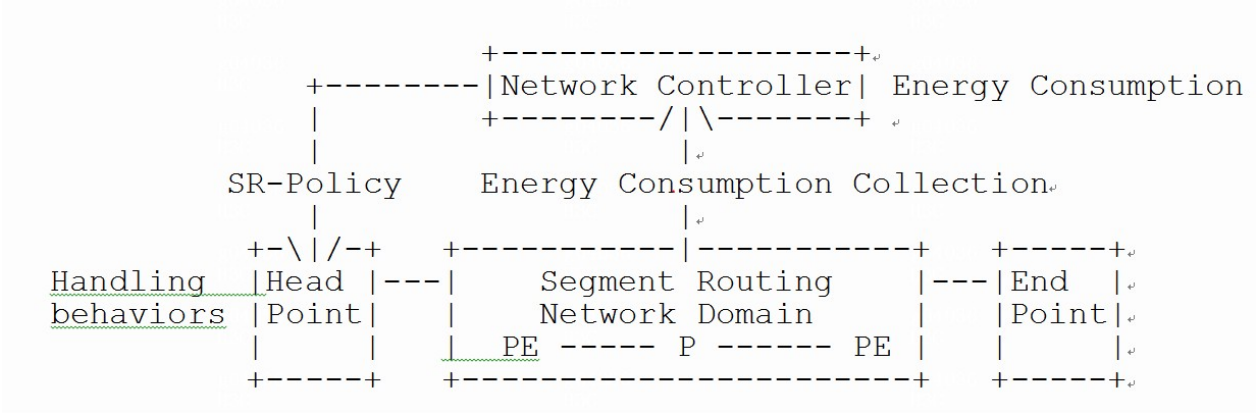

Energy Metrics:

- Multi-level Energy Consumption Metrics
- Static parameter & Dynamic parameter

Node level
--Board level
---Interface level

Watts per gigabyte (W/GB):
1) Maximum Energy Consumption: The energy consumed per unit of traffic when the device operates at maximum load.
2) Real-Time Energy Consumption: The energy consumed per unit of traffic under current operating conditions.

Energy Consumption Collection:

- IGP protocol extensions & BGP-LS extensions
- SNMP, NETCONF, Telemetry

Path Calculation Based on Energy Consumption:

- Diversified selection of energy consumption strategies
- Topology division to adapt to varying energy consumption requirements
- Threshold mechanism to prevent traffic oscillation

Issuance of Path:

- YANG, BGP, PCEP

Energy Metrics

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Node Energy Consumption:

- Node Maximum Energy Consumption: The power consumption of a node at full load.
- Node Real-Time Energy Consumption: The real-time power consumption of a node.
- Node Maximum Energy Consumption per Bit: The power consumption of a node at full load divided by traffic.(W/GB)
- Node Real-Time Energy Consumption per Bit: The real-time power consumption of a node divided by real-time traffic. (W/GB)
- Node Average Energy Consumption per Bit: The change in power consumption of a node over a measurement period divided by the change in traffic.(W/GB)

Interface Energy Consumption:

- Interface Maximum Energy Consumption per Bit: The power consumption of an interface at full load divided by traffic, measured in watts per gigabyte (W/GB).
- Interface Real-Time Energy Consumption per Bit: The real-time power consumption of an interface divided by real-time traffic, measured in watts per gigabyte (W/GB).
- Interface Average Energy Consumption per Bit: The change in power consumption of an interface over a measurement period divided by the change in traffic, measured in watts per gigabyte (W/GB).

Energy Consumption Collection

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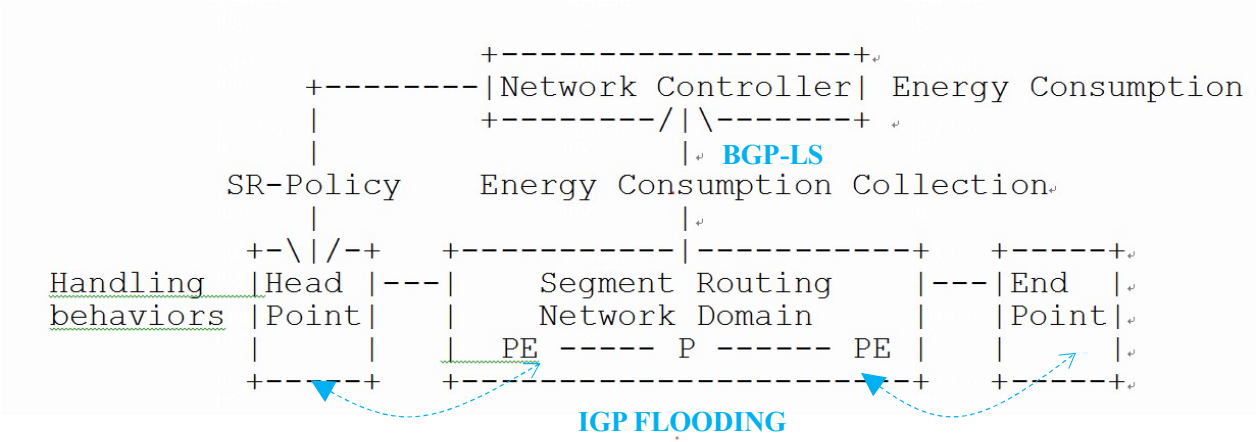
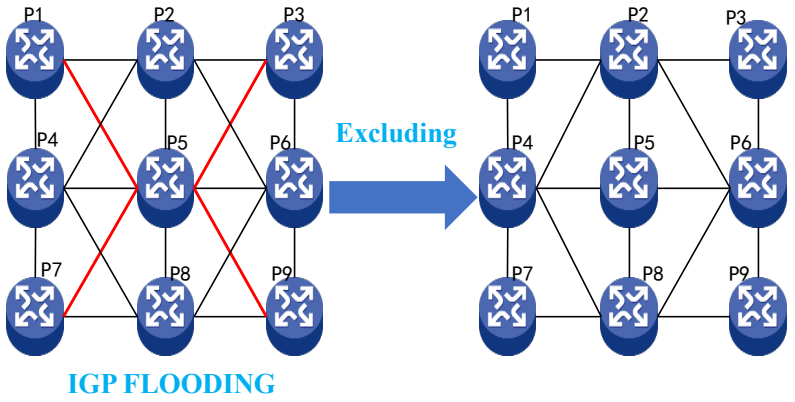
Method 1



Method 2



Centralized Low Energy Consumption Path Planning：

- IGP protocol floods energy consumption information within the domain and ultimately transmits it to the controller, enabling the controller to perform routing calculations based on energy consumption metrics.

Distributed Path Computation：

- The IGP floods energy consumption information within the domain and advertises a Flex-Algo with energy consumption metrics as path constraints. All nodes then exclude links that fail to meet the energy consumption requirements based on the algorithm's constraints, ultimately performing path calculation using the Shortest Path First (SPF) algorithm.

Next Steps

- Problems to be solved:
  - Methods for More Accurate Evaluation of Equipment Energy Consumption Levels
  - The Balance Between Parameter Reporting Frequency and Accuracy
  - More Principles for Low-Energy Consumption Path Planning
  - The effectiveness of energy efficiency strategies
- Absorb suggestions from the WG.
- Any questions or comments are Welcomed.

Thanks