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Path Energy Traffic Ratio API (PETRA)  
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## Abstract

This document describes an API to query a network regarding its Energy Traffic Ratio for a given path.

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## 1. Introduction

Sustainability is becoming one of the major societal goals for the next decade, and networks are one of the major consumers of energy nowadays. Sustainability of network services is thus one of the forefronts of innovation and action from network service stakeholders, involving manufacturers, operators and customers. In this line, there is a shared goal of achieving better energy awareness.

As with any other network metric, the energy traffic ratio could be collected from the underlying network infrastructure. However, there is not a common or single definition of energy metrics towards network consumers so that can be uniformly reported, particularly in heterogeneous network scenarios. This document introduces an API to query networks about Energy Traffic Ratio.

## 2. Terminology and Requirements Notation

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

## 3. Path Energy Traffic Ratio API (PETRA)

This document describes an API to query a network about the Energy Traffic Ratio for a given path. It takes as input the source and destination of a path along with the traffic throughput between and returns energy information related to the traffic on the path. This is energy computed by the infrastructure that is dynamically part of the traffic path. The API is agnostic to the actual hops and underlying infrastructure that enables a path, which might change transparently to the API. This document only describes the API, the computation of the energy information to return is out of the scope of this document.

### 3.1. Energy Information

This API allows to return a number of energy attributes associated with the path and the traffic. Currently the parameters that could be returned as energy information as part of the query are:

- \* Watts per Gigabit: How many Watts are consumed per Gigabit of traffic traversing the path.
- \* Carbon Intensity: How much carbon emissions are generated as a consequence of the energy consumed.

Some other parameters that could be considered as well as part of the energy information include:

- \* Renewable Percentage: How much of the energy consumed comes from renewable energy sources.
- \* ...

### 3.2. Recursive Usage

The API is envisioned in such a way that could be used recursively. That means, subpaths could report their energy consumption using PETRA and such energy consumption could be aggregated and reported for the overall path also using PETRA.

Similarly, this API could be (recursively) used to provide energy information according to the definition of Service Models in an SDN context as described in [RFC8309]. In that case, using Figure 3 in [RFC8309] as reference, PETRA could be used between the Controller(s) and the Network Orchestrator(s), between the Network Orchestrator(s) and the Service Orchestrator, and between the Service Orchestrator and the Customer(s).

While considering recursive usage, the aspect of double-counting shall also be taken into consideration. Double counting refers to the fact of counting more than once the same energy consumed. Organizations using PETRA in a recursive manner need to take appropriate measures to ensure no double-counting occurs across recursive calls to the API.

#### 4. YANG Module

This is a possible definition of PETRA as a module following the YANG specification [RFC6020].

##### 4.1. Module Structure

This section uses the graphical representation of data models defined in [RFC8340].

```
module: ietf-petra
  +-rw energy
    +---x query
      +---w input
        |   +---w src-ip          ietf-inet-types:ip-address
        |   +---w dst-ip          ietf-inet-types:ip-address
        |   +---w throughput      uint32
      +--ro output
        +--ro (result)?
          +--:(success)
            |   +--ro success
            |       +--ro watts-per-gigabit?    decimal64
            |       +--ro carbon-intensity?     uint32
          +--:(invalid-address)
            +--ro invalid-address
```

##### 4.2. Module Definition

```
<CODE BEGINS> file "ietf-petra@2024-07-05.yang"
module ietf-petra {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-petra";
  prefix ietf-petra;

  import ietf-inet-types {
    prefix ietf-inet-types;
  }

  organization
    "";
  contact
    "";
  description
    "Initial YANG rendition of the PETRA Energy API, v1.0.1

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    authors of the code. All rights reserved.

    Redistribution and use in source and binary forms, with or
    without modification, is permitted pursuant to, and subject to
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    forth in Section 4.c of the IETF Trust's Legal Provisions
    Relating to IETF Documents
    (https://trustee.ietf.org/license-info).

    This version of this YANG module is part of RFC XXXX
    (https://www.rfc-editor.org/info/rfcXXXX); see the RFC itself
    for full legal notices.

    The key words 'MUST', 'MUST NOT', 'REQUIRED', 'SHALL',
    'SHALL NOT', 'SHOULD', 'SHOULD NOT', 'RECOMMENDED',
    'NOT RECOMMENDED', 'MAY', and 'OPTIONAL' in this document
    are to be interpreted as described in BCP 14 (RFC 2119)
    (RFC 8174) when, and only when, they appear in all
    capitals, as shown here.
    ";

/*
  If you have an implementation of this YANG module, you could
  access it like something this over RESTCONF:

  $ curl --location --request POST \
    'https://localhost:8008/restconf/operations/energy/query' \
    --header 'Content-Type: application/yang-data+json' \
    --user 'admin:admin' \
    --data-raw '{
```

```

        'input' : {
            'src-ip': '10.10.10.10',
            'dst-ip': '10.20.20.20',
            'throughput': '40'
        },
    },
},

```

And if all goes well, you might receive (besides all the HTTP headers) a reply body with something like this:

```

{
  'output': {
    'success': {
      'watts-per-gigabit': '191.855',
      'carbon-intensity': '108'
    }
  }
}
*/

revision 2025-05-12 {
  description
    "Initial YANG rendition of the PETRA Energy API, v1.0.1";
  reference
    "RFC XXXX: ...";
}

grouping energy-metrics-g {
  description
    "Grouping for query result metrics.";
  leaf watts-per-gigabit {
    type decimal64 {
      fraction-digits 3;
    }
    units W/Gb;
    description
      "Watts consumed per Gigabit transmitted";
  }
  leaf carbon-intensity {
    type uint32;
    units gCO2e/kWh;
    description
      "Grams of CO2 per kWh";
  }
}

container energy {
  description

```

```
"PETRA API top level container.";
action query {
  description
    "Query the network for energy consumption";
  input {
    leaf src-ip {
      type ietf-inet-types:ip-address;
      mandatory true;
      description
        "Source IP address";
    }
    leaf dst-ip {
      type ietf-inet-types:ip-address;
      mandatory true;
      description
        "Destination IP address";
    }
    leaf throughput {
      type uint32;
      units Gb/s;
      mandatory true;
      description
        "Throughput between source and destination
        (in gigabits per second)";
    }
  }
  output {
    choice result {
      description
        "Choice of which kind of result the query gave.";
      container success {
        description
          "Successful operation";
        uses energy-metrics-g;
      }
      container invalid-address {
        description
          "Invalid source/destination IP address supplied";
      }
    }
  }
}
}
}
}
}
}
<CODE ENDS>
```

## 5. Security Considerations

TBD

## 6. Acknowledgments

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## 7. IANA Considerations

The IANA is requested to assign a new namespace URI from the IETF XML registry.

This document registers the following namespace URIs in the IETF XML registry [RFC3688]:

-----  
URI: urn:ietf:params:xml:ns:yang:ietf-petra

Registrant Contact: The IESG.

XML: N/A, the requested URI is an XML namespace.  
-----

This document registers the following YANG modules in the "YANG Module Names" registry [RFC6020]:

-----  
Name: ietf-petra

Namespace: urn:ietf:params:xml:ns:yang:ietf-petra

Prefix: petra

Reference: RFC XXX



---

## 8. References

### 8.1. Normative References

- [I-D.belmq-green-framework]  
Claise, B., Contreras, L. M., Lindblad, J., Palmero, M.,  
Stephan, E., and Q. Wu, "Framework for Energy Efficiency  
Management", Work in Progress, Internet-Draft, draft-  
belmq-green-framework-04, 7 July 2025,  
<<https://datatracker.ietf.org/doc/html/draft-belmq-green-framework-04>>.
- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate  
Requirement Levels", BCP 14, RFC 2119,  
DOI 10.17487/RFC2119, March 1997,  
<<https://www.rfc-editor.org/info/rfc2119>>.
- [RFC3688] Mealling, M., "The IETF XML Registry", BCP 81, RFC 3688,  
DOI 10.17487/RFC3688, January 2004,  
<<https://www.rfc-editor.org/info/rfc3688>>.
- [RFC6020] Bjorklund, M., Ed., "YANG - A Data Modeling Language for  
the Network Configuration Protocol (NETCONF)", RFC 6020,  
DOI 10.17487/RFC6020, October 2010,  
<<https://www.rfc-editor.org/info/rfc6020>>.
- [RFC6241] Enns, R., Ed., Bjorklund, M., Ed., Schoenwaelder, J., Ed.,  
and A. Bierman, Ed., "Network Configuration Protocol  
(NETCONF)", RFC 6241, DOI 10.17487/RFC6241, June 2011,  
<<https://www.rfc-editor.org/info/rfc6241>>.
- [RFC6242] Wasserman, M., "Using the NETCONF Protocol over Secure  
Shell (SSH)", RFC 6242, DOI 10.17487/RFC6242, June 2011,  
<<https://www.rfc-editor.org/info/rfc6242>>.
- [RFC6991] Schoenwaelder, J., Ed., "Common YANG Data Types",  
RFC 6991, DOI 10.17487/RFC6991, July 2013,  
<<https://www.rfc-editor.org/info/rfc6991>>.
- [RFC8040] Bierman, A., Bjorklund, M., and K. Watsen, "RESTCONF  
Protocol", RFC 8040, DOI 10.17487/RFC8040, January 2017,  
<<https://www.rfc-editor.org/info/rfc8040>>.

- [RFC8174] Leiba, B., "Ambiguity of Uppercase vs Lowercase in RFC 2119 Key Words", BCP 14, RFC 8174, DOI 10.17487/RFC8174, May 2017, <<https://www.rfc-editor.org/info/rfc8174>>.
- [RFC8309] Wu, Q., Liu, W., and A. Farrel, "Service Models Explained", RFC 8309, DOI 10.17487/RFC8309, January 2018, <<https://www.rfc-editor.org/info/rfc8309>>.
- [RFC8340] Bjorklund, M. and L. Berger, Ed., "YANG Tree Diagrams", BCP 215, RFC 8340, DOI 10.17487/RFC8340, March 2018, <<https://www.rfc-editor.org/info/rfc8340>>.

## 8.2. Informative References

### Appendix A. Use Cases

This section describes some use-cases where this specification might be useful.

#### A.1. SD-WAN

Software-Defined Wide-Area Networks (SD-WAN) have become a common way for enterprises to provide cost-effective connectivity across their different geographically distributed sites. Typically, SD-WAN deployments operate as an overlay network that is established on top of an existing underlay connectivity network. One aspect to consider is that in many SD-WAN production deployments the operator of the overlay network and the operator of the underlay network are different organizations.

This poses an additional challenge when trying to derive sustainability metrics. Even if the underlay network is instrumented to collect energy data, this data is opaque to the operator of the overlay network which has no access to underlay information. While operators of underlay networks offer certain general network metrics to overlay operators, no interface has been defined to allow the overlay operator to query the underlay network for energy information.

In this context, the PETRA specification presented in this document enables the operator of the SD-WAN network to coordinate with the underlay operator to capture sustainability data. This in turns opens further use-cases, from observability and reporting to potentially overlay policies based on underlay energy data, further enabling an overall more sustainable operation of the network.

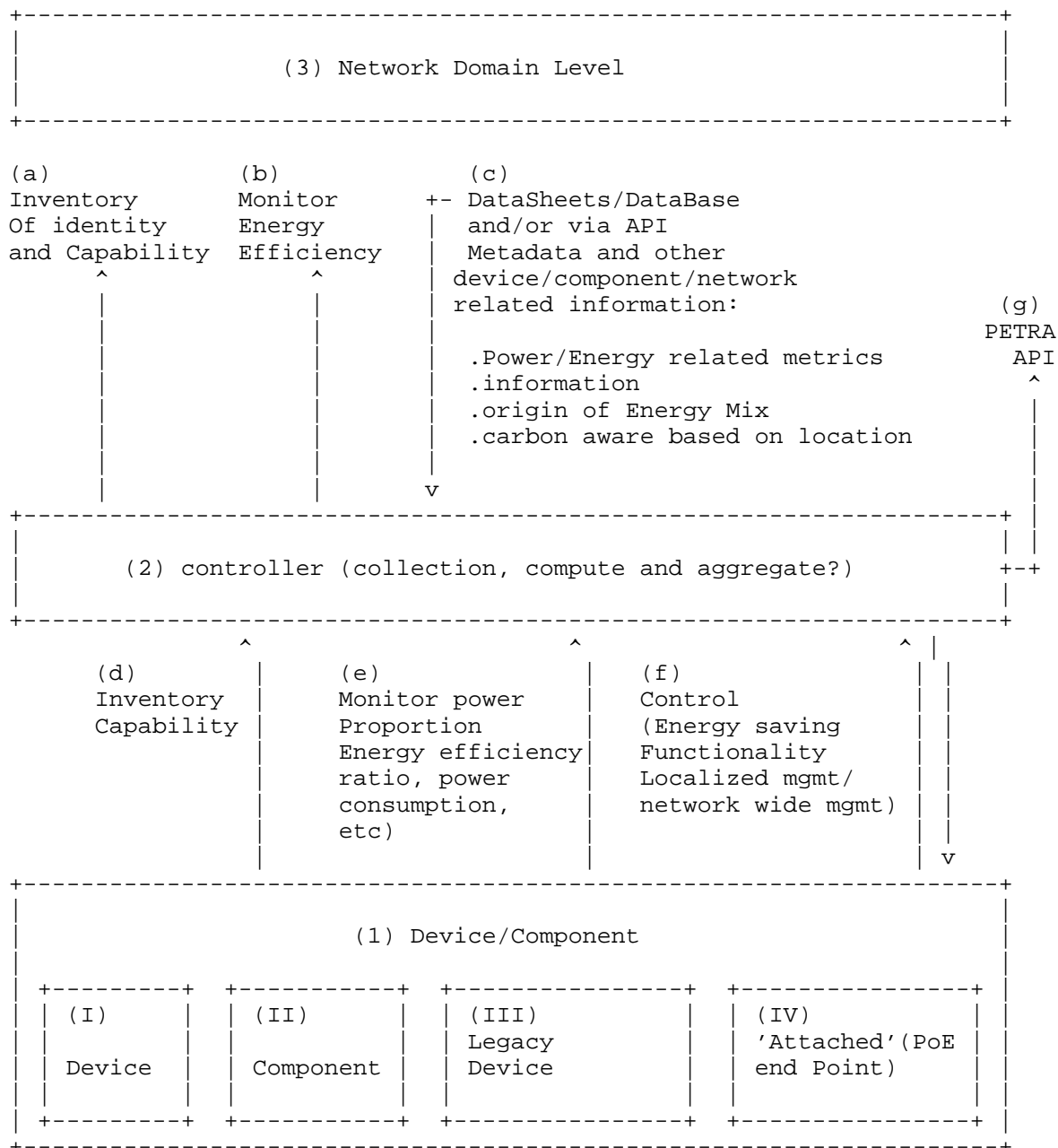
## A.2. Multilayer Energy Management

The concept of multilayer L3-L1 collection involves integrating data from different network layers to provide a comprehensive view of network operations. The use case of multilayer involves collecting and correlating data from Layer 3 (network layer) down to Layer 1 (physical layer). This multilayer approach allows for better network performance, optimization, and troubleshooting by providing end-to-end visibility.

Leveraging PETRA API for multilayer L3-L1 collection use case enhances energy management by providing comprehensive visibility, enabling optimization, and supporting proactive management. This makes PETRA a useful tool for more accurate, efficient and effective energy management in modern networks.

## Appendix B. Requirements for Energy Efficiency Management

The document Framework for Energy Efficiency Management [I-D.belmq-green-framework] describes a framework that comprises a controller element. In that document, the tasks of the controller are defined as "collection, compute and aggregate". In the context of that framework, the controller could also expose PETRA to offer path-related energy information. The figure below updates the one present in [I-D.belmq-green-framework] to add an additional interface (interface 'g') to the controller to represent the Path Traffic Ratio API.



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