Green Challenges & Usecase in CATS

draft-wang-cats-green-challenges-04
draft-wang-cats-usecase-green-00

Jing Wang, China Mobile(Presenter)
Yuexia Fu, China Mobile
Cheng Li, Huawei

Why Considering Green in CATS ?

- Reducing carbon footprint to “Net Zero” is one of mankind’s “grand challenges”
- With the continuous development and progress of the Internet, a large amount of computing resources is required to complete data processing, which would produce a lot of energy consumption
- *Computing-Aware Traffic Steering (CATS) is about the process of selecting service instances for directing traffic to them based on observed metrics for both computing and networking*
- So green in CATS is worth exploring

Challenges Summary

- **Computing resource energy consumption modeling**
- **Joint optimization of computing and network**
- **Service Experience Guarantee**
- **Energy Consumption of Other Equipment**
- **Evaluation of Computing Equipment Energy Consumption Performance**
- **Using of Green Energy**

Challenges (1/6)

- **Computing resource energy consumption modeling**
  - Computing resource status is considered in Cats, so it is necessary to research the modeling of computing resource energy consumption in order to save energy. The energy consumption of the equipment is different when the load is different.
    - For example, the energy efficiency of equipment is different when it is not loaded or at full load. Therefore, it is also a challenge to consider which factors to consider when modeling the energy consumption of computing resources.

Challenges(2/6)

Joint optimization of computing and network

- The magnitude of computing energy consumption may be different from the magnitude of network energy consumption, and how to weigh the ratio of the two becomes a challenge when performing joint optimization.

Challenges(3/6)

Service Experience Guarantee

- The magnitude of computing energy consumption may differ from the magnitude of network energy consumption. Therefore, when computing and network are jointly optimized, how to weigh the two in joint optimization becomes a challenge. When the computing energy consumption is large enough, the impact of network energy consumption on the joint optimization results is negligible.

Challenges(4/6)

- **Energy consumption of other equipment**
  - The computing resources may be in the data center, edge computing nodes or others.
    - In order to ensure the normal operation of network and computing equipment, the source of energy consumption is not only the equipment itself, but also some other equipment, such as : cool equipment.

Challenges(5/6)

Evaluation of Computing Equipment Energy Consumption Performance

- The energy efficiency level requirements of computing equipments can also be considered when performing traffic steering.
  - **High level**: less energy is consumed
  - **low level**: more energy is consumed
- There is no **standardized definition** of Evaluating computing equipment energy efficiency level.
  - It is difficult to consider the energy efficiency level of computing equipments when performing traffic steering.

Challenges(6/6)

- **Using of Green Energy**

- Green energy, also known as clean energy, including nuclear energy and renewable energy.


hydroelectric power


wind power


solar energy


geothermal energy

- The development of green CATS cannot be separated from the use of green energy.
  - The more green energy is used in CATS, the least carbon footprint is emitted. And the greener it is.
- The consideration of the consumption of green energy for equipment in traffic steering is incomplete and further research is needed.

A Usecase for Green CATS(1/2)

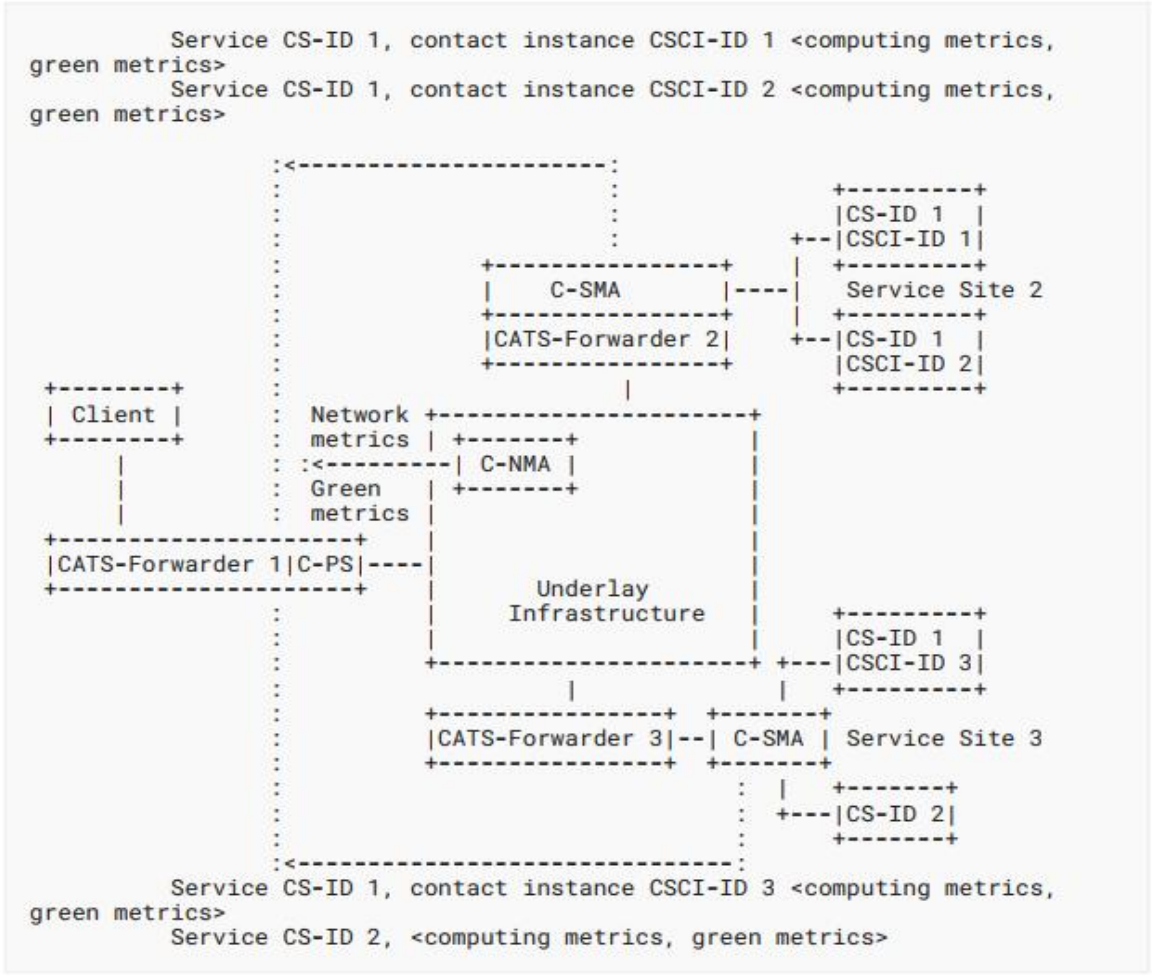

Figure.1 Distributed Model

Geared towards green computing-aware traffics Steering, the green metrics include the energy consumption of network devices as well as the energy consumption of computing resources. The following describes how green metrics are distributed under both **distributed and centralized models.**

Figure.1 shows an example of how Green CATS metrics can be disseminated in the distributed model. In this way, green metrics are distributed among network devices directly using distributed protocols without interactions with a centralized control plane.

A Usecase for Green CATS(2/2)

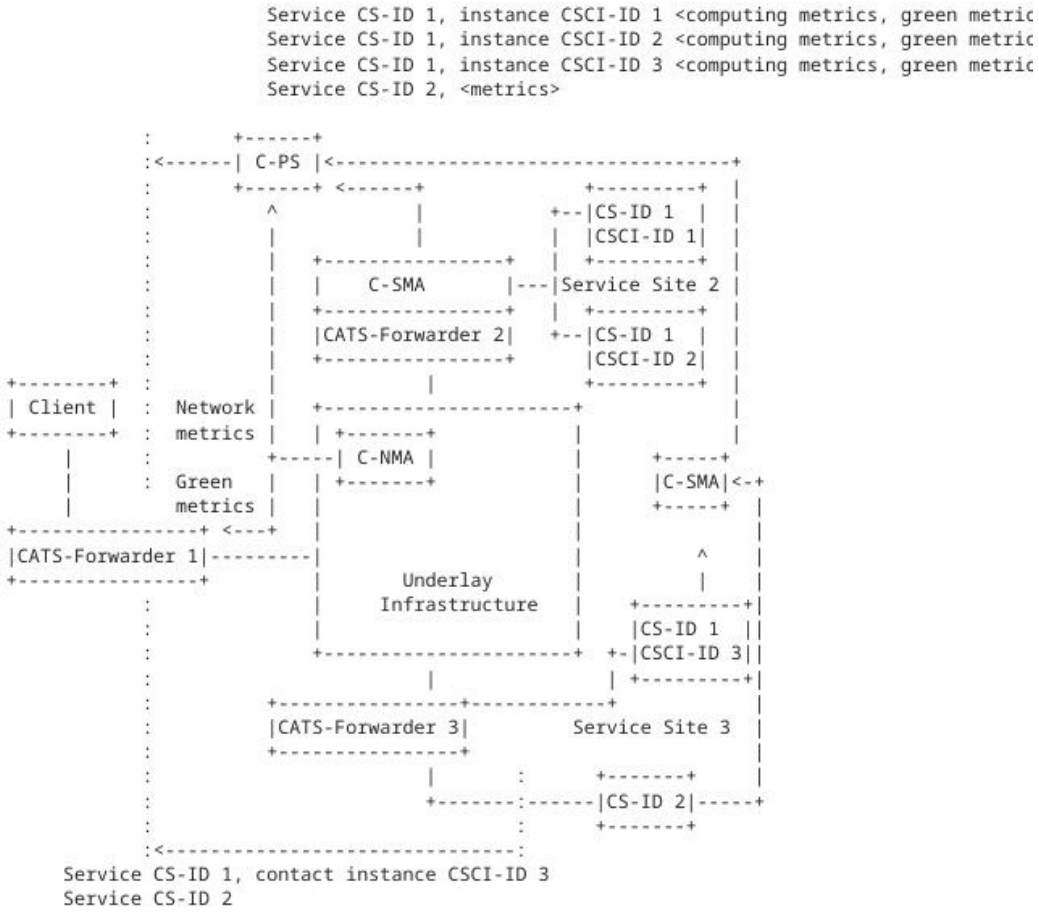

Figure.2 Centralized Model

In Figure.2, **network metrics, computing metrics, and green metrics can be distributed in a centralized way**. Green metrics are collected by the centralized control plane, and then the centralized control plane calculates the forwarding path corresponding to the energy efficiency demand request and synchronizes with the Ingress CATS-Forwarder.

Discussion

- Whether this is in scope of the current charter?
  The current charter doesn't directly describe green-related work.
- How/if you think this should be included in the WG document?
  In my opinion, it would have been better if this had been included in the WG document.

- Firstly, the computing metrics is a defining characteristic of the CATS WG. And the green challenges that have been previously introduced are closely linked to the implementation of computing metrics.
  - Therefore, It would be beneficial for the CATS WG to consider these challenges.
- Secondly, the current charter of the GREEN WG specifically focuses on network devices and does not encompass servers.
  - Therefore, it could be argued that CATS-green may not fall within the scope of GREEEN.
- In addition, access to green metrics in CATS is fundamental to addressing the green challenges in CATS, and access to green metrics can be achieved by extending the existing CATS framework.
  - **Therefore, I wonder if there is any possiblity to add the green-related work in CATS?**