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Operations, Administration and Maintenance (OAM) data collection for service decision-making in Computing-Aware Traffic Steering

draft-gao-cats-oam-data-collection-02

Abstract

This document describes the collection of OAM data for services decision-making in Computing-Aware Traffic Steering.In the following section, the main functional components and processes of OAM data collection will be elaborated in detail.

Status of This Memo

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1. Introduction

[I-D.fu-cats-oam-fw-02] establishes an end-to-end OAM for Computing-Aware Traffic Steering（CATS）, and the collection of indicators of computing resources and network status is an important component of Operations, Administration and Maintenance (OAM) for Computing-Aware Traffic Steering (CATS) . The collection of OAM data in Computing-Aware Traffic Steering (CATS) includes two stages. In the first stage, before the business is launched, Service Instance has not been selected and the path has not been planned. Based on measurement technology, end-to-end CATS OAM data is collected to support service decision-making; In the second stage, after the business is launched, real-time monitoring of network performance data and computing resource status is required to verify whether the calculation and selection results meet business requirements, and to achieve adjustments to service instances and network paths. This article focuses on stage one and elaborates on the process of collecting network OAM and computing power OAM data as input for C-PS decision-making before business activation, in order to achieve the selection of service instances and paths planning.

2. Conventions and Definitions

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.

This document uses terms defined in [I-D.ldbc-cats-framework]. We list them below for clarification.

* Computing-Aware Traffic Steering (CATS): A traffic engineering approach RFC9522] that takes into account the dynamic nature of computing resources (e.g., compute and storage) and network state to optimize service-specific traffic forwarding towards a given service contact instance. Various relevant metrics may be used to enable such computing-aware traffic steering policies.

* CATS-Forwarder: A network entity that makes forwarding decisions based on CATS information to steer traffic specific to a service request towards a corresponding yet selected service contact instance. The selection of a service contact instance relies upon a multi-metric path computation

* Ingress CATS-Forwarder: An entity that steers service specifictraffic along a CATS-computed path that leads to an Egress CATS-Forwarder that connects to the most suitable service site that host the service contact instance selected to satisfy the initial service request

* Egress CATS-Forwarder: An entity that is located at the end of a CATS-computed path and which connects to a CATS-serviced site

* CATS Path Selector (C-PS): A functional entity that computes and selects paths towards service locations and instances and which accommodates the requirements of service requests. Such a path computation engine takes into account the service and network status information

* CATS Service Metric Agent (C-SMA): A functional entity that is responsible for collecting service capabilities and status, and for reporting them to a CATS Path Selector (C-PS)

3. Requirements and Motivation

Before the business is launched, the goal of collecting CATS OAM data in this stage is for C-PS to make decision to achieve the selection of service instances and paths planning. The collection of network OAM includes hop by hop and end-to-end data, with different collection requirements in different scenarios. For example, Ingress CATS Forwarder collects network hop by hop OAM and computing power OAM based on anycast forwarding method, and finally calculates end-to-end OAM based on the collected data to determine the optimal service instance and implement path planning; In additon, collect end-to-end CATS OAM data directly and evaluate the optimal path and calculation instance based on the results. The network OAM data includes status information such as network latency and packet loss. It consists of three parts: internal carrier network, the inter domain link between the carrier network and the cloud network, and Internal cloud network.Computing power OAM data refers to the status of computing service instances, etc.

4. Framework and Components

[I-D.ldbc-cats-framework-06]defines the CATS framework and components.

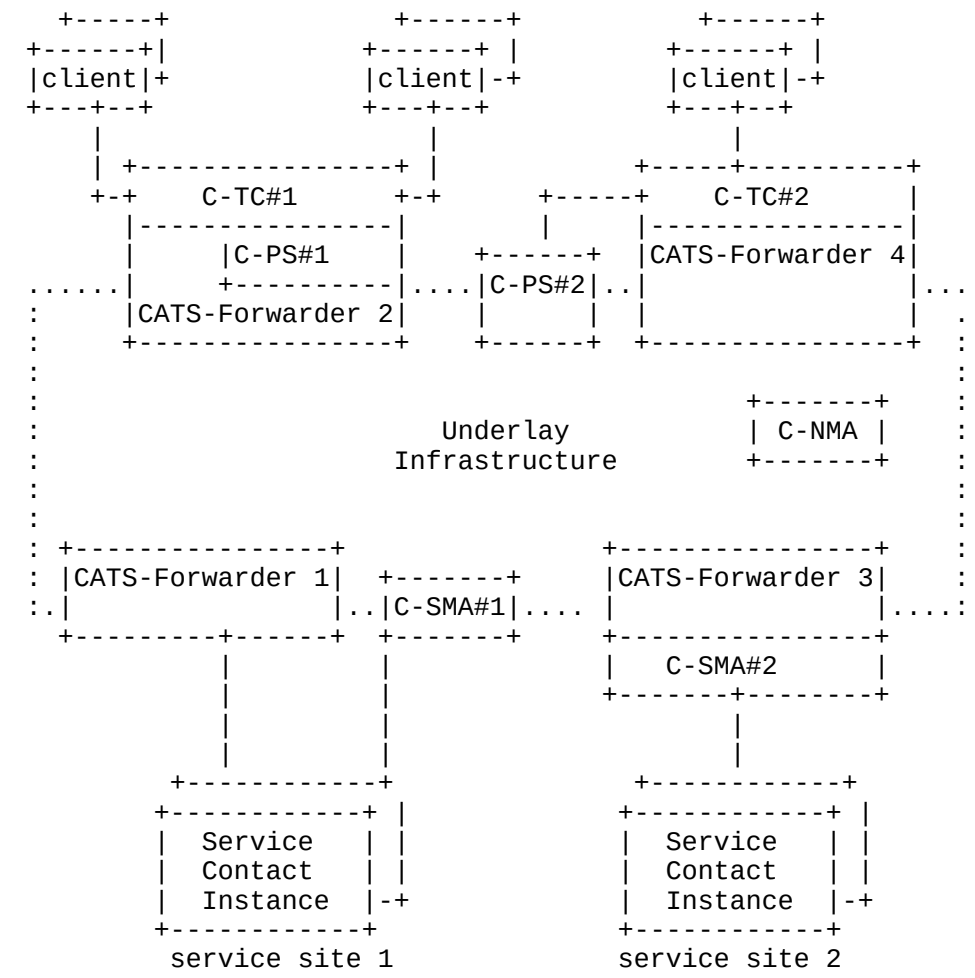

Figure 1: CATS-Functional-Components

The CATS Service Metric Agent (C-SMA) is a functional component that gathers information about service sites and server resources, as well as the status of the different service instances. C-SMA can be deployed as a standalone component or hosted by the Egress CATS-Forwarder. CATS Path Selectors (C-PSes) use OAM information to select the Egress CATS-Forwarders where to forward traffic for a given service request. C-PSes also determine the best paths to forward traffic, according to various criteria that include network state and traffic congestion conditions. A C-PS can be integrated into CATS-Forwarders or may be deployed as a standalone component . The method of deploying as independent components is called independent deployment, and the method of deploying integrated in CATS transceivers is called distributed deployment.

5. OAM data collection under different architectures

Based on the distributed and centralized deployment architecture of C-PS and C-SMA, network OAM and computing OAM can be independently or jointly collected.

5.1. Option 1: Centralized C-SMA + Centralized C-PS

* Independent collection of network OAM:

End to end performance data collection: It supports both pre arranged paths (such as SRv6 Policy) and non arranged paths.Ingress CATS-Forwarder initiates active measurements, collects performance data from the Ingress CATS-Forwarder to the service instance, Ultimately, The Ingress CATS-Forwarder reports network OAM data to C-PS, For example, BGP-LS protocol and telemetry can be used.

Performance data collection for hop by hop links: Performance data is collected between each link based on active measurements (such as Twamp), including links within the host network, between the host network and cloud network domains, and within the cloud network. The collected performance data is ultimately reported to C-PS.

* Independent collection of computing power OAM:

C-SMA collects computing power OAM data and transmits it to C-PS through API interfaces and other methods.

* Collaborative collection of network OAM and computing power OAM:

The request and response mechanisms of network protocols can be used to jointly collect network OAM and computing power OAM. Data collection is initiated at Ingress CATS-Forwarder, and network devices collect network status information (such as packet loss and

delay). The network status information collection instruction header and statistical data can be placed in the extension header of IPv6. The receiver (service instance) adds computing OAM information and network OAM information collected along the way in the ACK in the response.For example, through the extension of the stamp protocol, while measuring network OAM information, computing power OAM information can be collected together. Finally, the Ingress CATS-Forwarder reports the CATS OAM data to C-PS,BGP-LS protocol and telemetry can be used.

5.2. Option 2: Centralized C-SMA + Distributed C-PS

* Independent collection of network OAM:

End to end performance data collection: It supports both pre arranged paths (such as SRv6 Policy) and non arranged paths.Ingress CATS-Forwarder initiates active measurements, collects performance data from the Ingress CATS-Forwarder to the service instance.

Performance data collection for hop by hop links: Performance data is collected between each link based on active measurements (such as Twamp), including links within the host network, between the host network and cloud network domains, and within the cloud network. Finally, The collected performance data will be notified to Ingress CATS-Forwarder.

* Independent collection of computing power OAM:

The method is the same as option 1. C-SMA collects computing power OAM data and transmits it to C-PS through API interfaces and other methods.

* Collaborative collection of network OAM and computing power OAM:

Similar to option 1,The difference is that the ACK carrying network OAM and computing OAM information can be finally notified to the C-PS integrated and deployed in Ingress CATS-Forwarder.

5.3. Option 3: Distributed C-SMA + Centralized C-PS

* Independent collection of network OAM:

The method is the same as option 1.

* Independent collection of computing power OAM:

C-SMA collects computing power OAM data and transmits it to C-PS through API interfaces and other means.

* Collaborative collection of network OAM and computing power OAM:

Similar to option 1,The difference is that the receiver of the request and response mechanism is the Egress CATS- Forwarder, as C-SMA is hosted by the Egress CATS- Forwarder.(In this case, network status indicators such as latency, packet loss, and bandwidth are measured between the Egress CATS- Forwarder and service instance, and these measurement results are usually fed back to the Egress CATS-Forwarder).

5.4. Option 4: Distributed C-SMA + Distributed C-PS

* Independent collection of network OAM:

The method is the same as option 2.

* Independent collection of computing power OAM:

The method is the same as option 3.

* Collaborative collection of network OAM and computing power OAM:

Similar to option 3,The difference is that the ACK carrying OAM data is ultimately notified to the C-PS integrated and deployed in Ingress CATS-Forwarder.

6. Security Considerations

TBD

7. IANA Considerations

TBD

8. References

8.1. Normative References

[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>.

[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>.

8.2. Informative References

[I-D.ldbc-cats-framework]
Li, C., Du, Z., Boucadair, M., Contreras, L. M., and J. Drake, "A Framework for Computing-Aware Traffic Steering (CATS)", Work in Progress, Internet-Draft, draft-ldbc-cats-framework-06, 8 February 2024, <https://datatracker.ietf.org/doc/html/draft-ldbc-cats-framework-06>.

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付楷, Liu, B., Li, Z., Huang, D., Huang, C., Ma, L., and W. Duan, "Operations, Administration and Maintenance (OAM) for Computing-Aware Traffic Steering", Work in Progress, Internet-Draft, draft-fu-cats-oam-fw-02, 25 February 2025, <https://datatracker.ietf.org/doc/html/draft-fu-cats-oam-fw-02>.

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