CATS
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H. Yao
China Mobile
X. Wang
Ruijie Networks
Z. Li
China Mobile
D.H. Daniel
ZTE Corporation
C. Lin
New H3C Technologies
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Computing and Network Information Awareness (CNIA) system architecture for CATS
draft-yao-cats-awareness-architecture-02

Abstract

This document describes a Computing and Network Information Awareness (CNIA)system architecture for Computing-Aware Traffic Steering (CATS). Based on the CATS framework, this document further describes a proposal detailed awareness architecture about the network information and computing information. It includes a new component and the corresponding interfaces and workflows in the CATS control plane.

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1. Introduction

Computing-Aware Traffic Steering (CATS)[I-D.ldbc-cats-framework]aims to solve the problem of how the network edge can steer traffic between clients of a service and sites offering the service. To enable the computing- and network-aware traffic steering decisions, awareness of computing information and network information is the foundation.

Currently there are some work being done on the classification and awareness of computing and network information. As described in[I-D.du-cats-computing-modeling-description], there could be two models of computing information: one is some detailed computing parameters, and another is a comprehensive computing level parameter.

Further, the former includes some static information such as service ability, and some dynamic information such as service status. This modeling document could be a solid foundation of CATS. For the awareness solution of computing and network information, the current recommended methods are generally BGP[I-D.ietf-idr-5g-edge-service-metadata], BGP-LS[I-D.ls-idr-bgp-ls-service-metadata], and BGP-FS[I-D.yi-idr-bgp-fs-edge-service-metadata]. CATS Service Metric Agent(C-SMA) and CATS Path Selector (C-PS) components defined in [I-D.ldbc-cats-framework] could be deployed in different locations.

Overall, the current awareness technology is some sporadic solutions. This document hopes to comprehensively sort out the computing and network awareness method and defines a comprehensive awareness architecture to support the different types of computing and network information, to facilitate the deployment of CATS. This awareness architecture acts as the control plane of CATS.

2. Architecture Components and Interfaces

To consider various kinds of computing and network information, a control center component is additionally introduced on the basis of CATS framework. That is, CATS framework includes a control center and CAT routers. A control center performs computing management and control functions, including computing information awareness function, service scheduling function, etc., A control center collects computing and network information, and schedules service based on computing and network information. CATS Router collects omputing and network information, and schedules service based on computing and network information, then forwarding data packets based on service scheduling. As a comprehensive awareness architecture CNIA supports both distributed,centralized,hybrid awareness models.

For some coarse-grained and relatively static information with low update frequency, it is recommended to be aware in a distributed way. The distributed way has better robustness and high scalability. For some fine-grained dynamic information with a high update frequency, it is recommended to aware it in a centralized way. Frequent information updates will greatly increase the burden on network devices and are not conducive to information convergence. The centralized way is more suitable for the management of fine- grained dynamic information. This comprehensive-aware model is consistent with the design philosophy of segment routing architecture[RFC8402]. The services that require planning for dynamic resources, such as TE(Traffic Engineering), are implemented by a centralized controller. The BE(best-effort) service is still preserved on the devices and implemented in a distributed manner, which could take advantage of distributed robustness and reduce the burden of interfacing between the controller and devices, facilitating deployment.

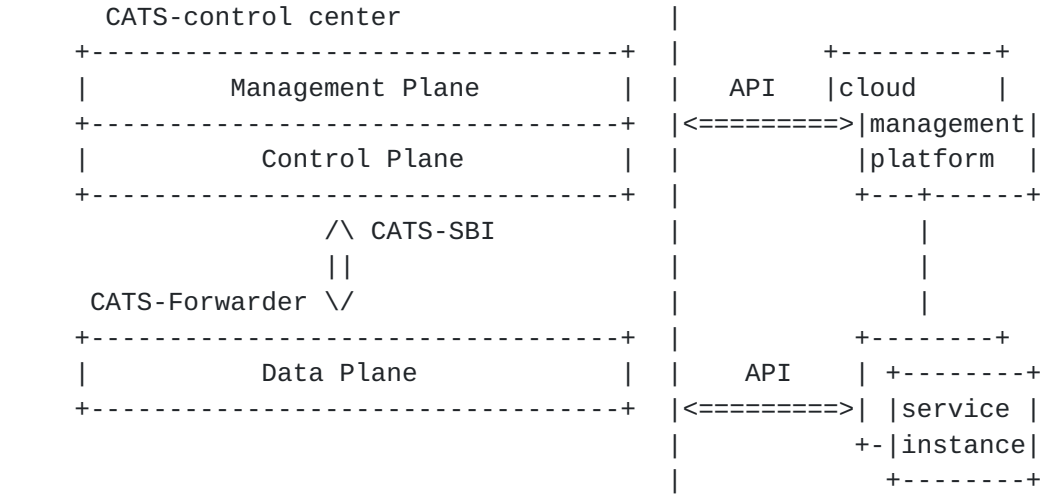

Figure 1: CNIA System Arhicteture

To realize the scheduling of fine-grained computing information, the control center introduces several components and interface:

CATS Computing information Base(C-CIB): Maintain fine-grained computing information, such as service connections,CPU performance,which may be obtained from the CATS-Forwarders or from the cloud management platform.

CATS Network Metric information Base(C-NIB): Maintain fine-grained network information, such as remaining bandwidth,delay, which could be obtained from the routers.

CATS Path Calculation Unit(C-PCE): Calculate optimal computing resource and network path based on C-CIB and C-NIB, and generate path policy and deliver to the CATS-Forwarders.

CATS-SBI interface: An extended interface based on the traditional controller southbound interface between the CATS-Forwarders and the CATS-control center, could be used to report network and computing information from CATS routers to the CATS-control center, and also could be used to send path and service policy information or compute information to CATS-Forwarders.

C-SMA API: An extended interface based on the traditional controller southbound interface between the CATS-Forwarders and the cloud management or between CATS-Forwarders and service-instance, used to report network and computing information to the CATS-control center or to CATS-Forwarders.

Given the comprehensive architecture described above, this document proposes a comprehensive awareness system of the deployment location, real-time resource and service status, load information and requirements of computing resources and services. On the one hand, the network aggregates the computing and network metrics reported by multiple nodes to build a globally unified computing and network status view. On the other hand, the network completes the unified analysis of service, computing and network requirements, realizes the comprehensive perception and provides guarantee for computing-aware scheduling based on service requirement.

3. Architecture Workflow

3.1. Awareness Information Classification

Currently the detailed network and computing parameters used by CATS have not yet reached a consensus in the industry, in order to avoid introducing too much signaling overhead into the whole network advertisement, this document proposes to classify the content of the computing advertisement according to the characteristics of the content and frequency of information announcement, and adopt different information awareness methods and information announcement protocols. As shown in Table 1, the computing and network information could be classified into capability information and status information. Capability information contains the deployment location and identifier information, and so on. Status information tends to be some real-time status parameters of the network and computing, such as remaining bandwidth,delay,service connections,CPU performance. This type of information is mainly used for some services that are sensitive to network and computing status, such as AR/VR services.

Awareness information	Network information	Computing information
Capability parameters	Device location; Device type; Topology information	Service ID; Service-domain name; Computing energy consumption; Computing cost; Peak value of available computing
Status parameters	Service policy information; Traffic information (bandwidth,delay,packet loss rate,delay jitter)	Number of available service connections; Available resources; CPU/GPU/NPU performance; Storage capacity; Service delay

Table 1: Awareness information content examples

Table 1 provides some detailed parameters examples about the two kinds of awareness information.

3.2. Workflow

3.2.1. A centralized model

In centralized mode, the collection of computing information and the selection of paths are implemented by the controller, which is then sent to the CATS-Forwarder via the CATS-SBI interface.

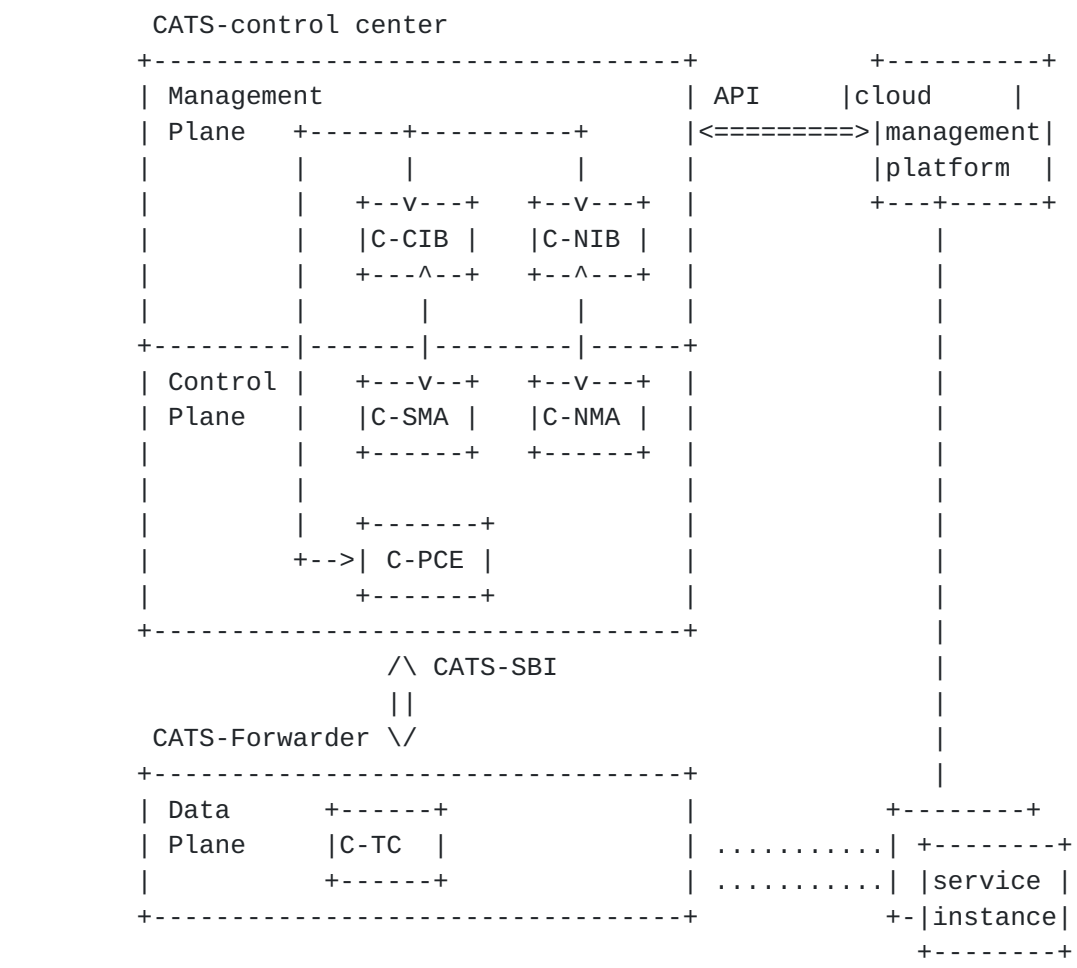

Figure 2: centralized model

For some services that are sensitive to computing and network status, especially latency, such as AV/VR services, the network needs to be able to perceive detailed computing information and network information to meet the strict requirements of the service. This kind of computing information could be aware by the CATS-control center by restful interface from cloud management platform. The network information could be aware by the BGP-LS or telemetry interface to get the status parameters such as remaining bandwidth and the delay. Further, CATS-control center performs service scheduling according to the computing information and network information, then generates routing policy and sends to CATS ingress router . When CATS ingress router receives the service demand from the client, it selects the optimal service instance and network policy, and maintains the instance affinity subsequently.

3.2.2. A hybrid model

In hybrid mode, both the controller and the CATS-Forwarder with routing capabilities can perform the collection of computing information and the selection of paths. The CATS-Forwarder with routing capabilities can perform more precise path selection operations based on instructions from the controller. CATS-Forwarders without routing capabilities, on the other hand, directly forward data based on the results provided by the controller.

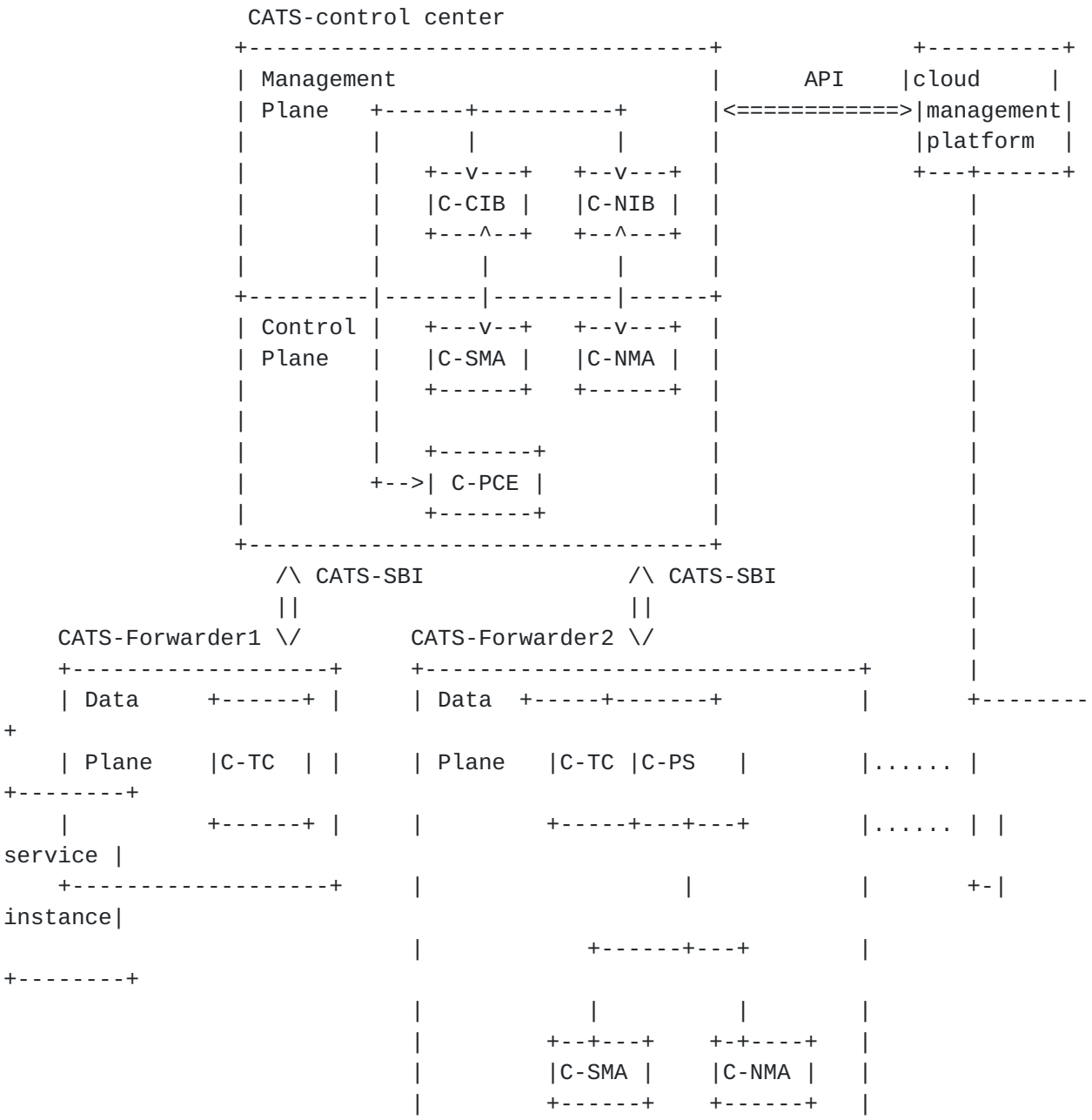

Figure 4: hybrid model

For some high-value customers, hybrid awareness can be deployed to accurately match customer requirements. After the CATS-control center obtains computing and network information through SBI or restful interfaces, the details of this information are directly transmitted to the CATS ingress routers. The device performs accurate resource matching and continuous experience detection after receiving service traffic.

3.2.3. A distributed model

In distributed mode, these operations are performed by the CATS-Forwarder itself, while the controller is responsible for monitoring the information.

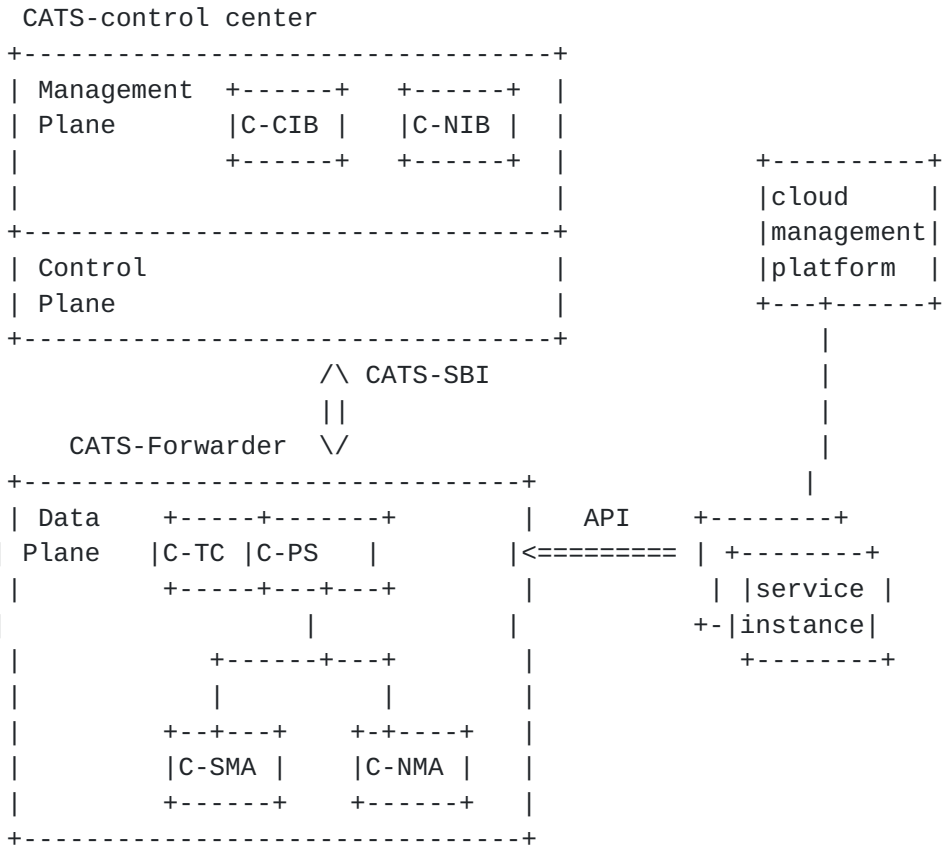

Figure 3: distributed model

For distributed mode, the ingress CATS router responsibles for collecting computing and network information and scheduling service. When the ingress CATS router receives the service demand from the client it makes decision of the service instance to access independently according to the service instances status and network status and maintains instance affinity. The detailed workflow can be seen in[I-D.ldbc-cats-framework].

4. IANA Considerations

TBD

5. Security Considerations

TBD

6. References

6.1. Normative References

[RFC8402] Filsfils, C., Ed., Previdi, S., Ed., Ginsberg, L., Decraene, B., Litkowski, S., and R. Shakir, "Segment Routing Architecture", RFC 8402, DOI 10.17487/RFC8402, July 2018, <https://www.rfc-editor.org/info/rfc8402>.

6.2. Informative References

[I-D.ietf-idr-5g-edge-service-metadata] Dunbar, L., Majumdar, K., Wang, H., Mishra, G. S., and Z. Du, "BGP Extension for 5G Edge Service Metadata", Work in Progress, Internet-Draft, draft-ietf-idr-5g-edge-service- metadata-04, 6 July 2023, <https://datatracker.ietf.org/doc/html/draft-ietf-idr-5g-edge-service-metadata-04>.

[I-D.ls-idr-bgp-ls-service-metadata] Li, C., Shi, H., He, T., Pang, R., and G. Qian, "Distribution of Service Metadata in BGP-LS", Work in Progress, Internet-Draft, draft-ls-idr-bgp-ls-service-metadata-01, 24 February 2023, <https://datatracker.ietf.org/doc/html/draft-ls-idr-bgp-ls-service-metadata-01>.

[I-D.yi-idr-bgp-fs-edge-service-metadata] yixinxin, He, T., Shi, H., Ding, X., and H. Wang, "Distribution of Service Metadata in BGP FlowSpec", Work in Progress, Internet-Draft, draft-yi-idr-bgp-fs-edge-service-metadata-00, 23 February 2023, <https://datatracker.ietf.org/doc/html/draft-yi-idr-bgp-fs-edge-service-metadata-00>.

[I-D.ldbc-cats-framework] Li, C., Du, Z., Boucadair, M., Contreras, L. M., Drake, J., Huang, D., and G. S. Mishra, "A Framework for Computing-Aware Traffic Steering (CATS)", Work in Progress, Internet-Draft, draft-ldbc-cats-framework-02, 22 June 2023, <https://datatracker.ietf.org/doc/html/draft-ldbc-cats-framework-02>.

[I-D.du-cats-computing-modeling-description] Du, Z., Fu, Y., Li, C., Huang, D., and Z. Fu, "Computing Information Description in Computing-Aware Traffic Steering", Work in Progress, Internet-Draft, draft-du- cats-computing-modeling-description-01, 4 July 2023, <https://datatracker.ietf.org/doc/html/draft-du-cats-computing-modeling-description-01>.

Authors' Addresses

Huijuan Yao
China Mobile
No.32 XuanWuMen West Street
Beijing
100053
China
Email: yaohuijuan@chinamobile.com

Xuewei Wang
Ruijie Networks
Beijing
China
Email: wangxuewei1@ruijie.com.cn

Zhiqiang Li
China Mobile
No.32 XuanWuMen West Street
Beijing
100053
China
Email: lizhiqiangyjy@chinamobile.com

Daniel Huang
ZTE Corporation
Nanjing
Phone: +86 13770311052
Email: huang.guangping@zte.com.cn

Changwang Lin
New H3C Technologies
Beijing
China
Email: linchangwang.04414@h3c.com