CTC Experiences on Building Computing Power Network

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Abstract: For the optimum leveraging of distributed computing and network resources in the network for various services, we proposed an advanced architecture of Computing Power Network (CPN) with the development of CPN gateway and transaction platform.© 2022 The Author(s)

1 Introduction

Massive growth in newly emerging services and applications leveraging artificial intelligence techniques and Internet, such as industrial network, internet of vehicles, smart city, has contributed to significant rise in data storage and processing requirements. Data generated globally is predicted to reach 142.6ZB in 2024, and there will be 55.9 billion networked devices by 2025[1]. A large amount of computing resources are needed to support data processing, which promote the deployment of infrastructure with computation capacities measuring by "Computing power" which is a measure of computation performance of a device, representing the amount of data being processed in one second according to the change of internal state of device, which is measured in FLOPS (floating operations per second). Computing power is classified into general computing power, intelligent computing power and high-performance computing power, where general computing power provides basic computation capacity based on CPU chips, intelligent computing power provides computation for AI model training and reasoning based on GPU, PGA, ASIC, etc., high-performance computing power is provided by high-performance computing cluster.

In the network, it is difficult for the users to wisely choose the computing resources and corresponding network connections to meet their requirements on performance and cost. To solve these problems, network technology- Computing Power Network (CPN) is purposed[2], which realizes the optimum resource allocation by distributing computing, storage, network and other resource information of the service nodes through the network control plane (such as centralized controller, distributed routing protocol, etc.). It considers the network conditions and user requirements to provide the optimal distribution, association, transaction and scheduling of computing, storage and network resources, improves service quality and the utilization rate of resources.

2 Advanced Technical Structure of CPN

CTC has been engaging in the research of CPN since 2019. In ITU-T, recommendation Y.2501 "Computing power network - Framework and architecture" had been approved as the first international specification in the research of CPN, in which potential use scenarios, general framework, and functional architecture were described for further study[3]. Based on Y.2501, CTC improved the architecture proposed in Y.2501 for building a more comprehensive technical structure, which is illustrated in Figure 1.

The layer of Network Resource is comprised of the network resources, including IP network, transmission network, 4G/5G and cutting-edge network technologies and protocols over network infrastructure. The layer of Computing Resource provides computation capability for various applications, facilitated by computing power infrastructure such as end computing power, edge computing power, cloud, storage, etc.

Computing-Network Resource Awareness layer collects the information of computing resources and network resources to formulate topology of network for the integrated orchestration and management of computing resource and network resource.

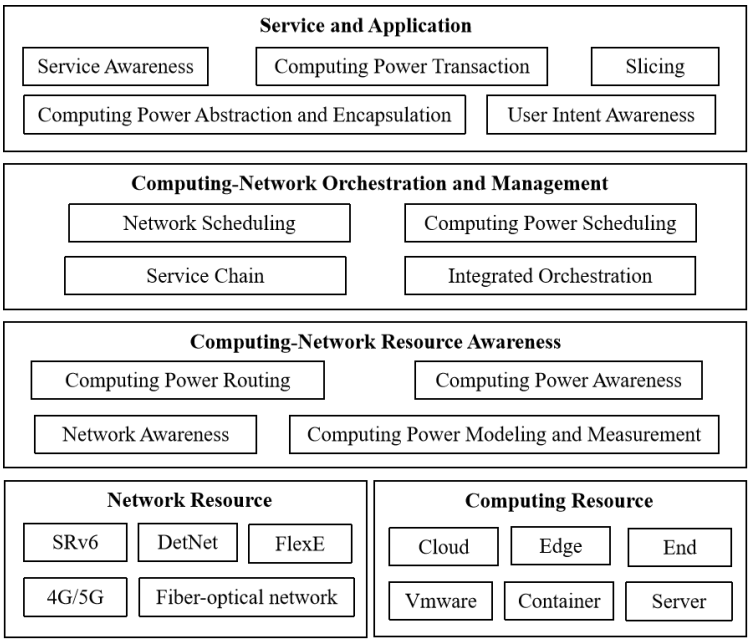

Fig. 1. Advanced technical structure of CPN.

The CPN orchestration and management layer realizes flexible scheduling and provision of computing resources and network resources by integrated control and management.

Service and Application layer realizes the functions of service awareness, computing power transactions, service slicing, computing power encapsulation, and intelligent analysis of user intention and demands.

3 CTC Experiences on Building CPN

3.1 Equipment Research and Development

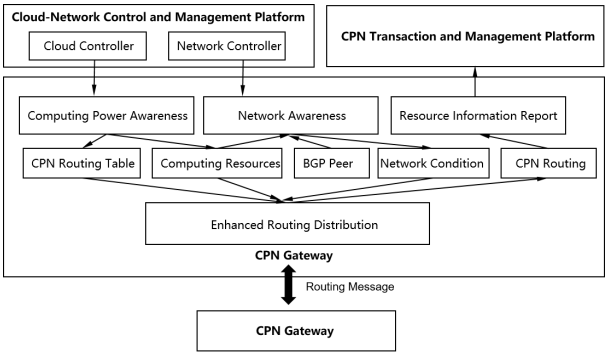

Fig. 2. Architecture of CPN Gateway

Figure 2 is shows the architecture of CPN gateway which is designed and developed by CTC. As the access point of computing resources into the network, CPN gateway has the function of interaction, distribution and transaction of computing resources, and the function of establishing the network connection between the computing resources and the users in support of computing power transaction and management platform. CPN gateway notifies the computing routing nodes and other gateway the information of the computing resources connected with the it by expanding BGP/IGP protocol.

3.2 CPN Transaction Platform

CPN transaction platform allows CPN providers to provide their computing resources (including centralized DC or resources distributed at the edge) to the CPN users based on the demands and requirement of them. CPN transaction platform should support the following functionalities:

Information collection and processing: CPN transaction platform collects the information of computing resource and network resource and the consumers' demands. According to these information, it provides CPN consumers a transaction view by which CPN consumers can choose the computing resources meeting their demands. The platform is capable of analysis and interpreting the consumers' demands by using AI technologies and provides optional resources and reasonable price based on the construction cost, maintenance cost, scarcity, and competition relationship of them.

Resource transaction and billing: CPN transaction platform is responsible for establishing the connections between CPN providers and CPN consumers and formulating the policy of resource allocation and billing after receiving or interpreting the consumers' requirements. There are two kinds of bills. One is paying bills for computing power consumers according to the occupation statistics of computing power resources and network resources. The other is income bills for computing power providers and network operators according to the supplement of computing power resources and network resources.

4 Conclusion

We proposes an advanced architecture of CPN, which realizes the best resources selection and flexible scheduling for users. With the research and development on CPN gateway and CPN transaction platform, we have reached a state of maturity to deploy the system in production and achieve wise and effective use of computing power resources in various formulation and structure.

5 Reference

[1] Bo Lei and Qianying Zhao, "CPN: A joint Optimization Solution of Computing/Network Resources," Frontiers of Data & Computing, 2020, vol. 2, pp.53-62.

[2] Bo Lei et al., "A new edge computing solution based on the interworking among cloud, network and edge: Computing power network," Telecommunication Science, vol.9, 2019, pp.:44-51.

[3] ITU-T. Recommendation ITU-T Y. 2501: "Computing power network – Framework and architecture"[Z].2021.