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Multiattribute Evaluation Model Based on the KSP Algorithm for Edge Computing

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ABSTRACT To solve the problems of single evaluation attributes and highly overlapping trust paths in the current trust model, a multiattribute trust evaluation model based on the K shortest paths (KSP) algorithm is proposed. The model refines the evaluation attributes among nodes and uses the analytic hierarchy process (AHP) to allocate the weights based on users' preferences to meet the special needs of individual users. Also, the model introduces the penalty factor algorithm idea of KSP and proposes a trust path optimization algorithm RKSP based on the A* algorithm. It can filter highly overlapping trust paths during the formation of recommended trust paths so that the searched trust paths have certain differences. Through comparative experiments, it is proven that the model can reduce the resource overhead of edge devices, improve the accuracy of evaluation, ensure load balancing within the domain, and better align the results of the model recommendation with user needs.

INDEX TERMS trust model; multiattribute; trust path; KSP algorithm

I. INTRODUCTION

The rise of the Internet of Everything and 5G technology leads to new computing models such as fog computing [1], edge computing [2] and mobile edge computing [3]. Edge computing can provide near ground real-time computing and storage functions through smartphones, cameras, wearable devices, smart gateways, etc. It can reduce the pressure of the cloud computing center and network bandwidth, with the advantages of low latency and high energy efficiency [4], [5]. Moreover, it has a good application effect in intelligent car networking, virtual reality, healthcare, smart homes, smart cities, industrial Internet of Things and other scenarios [6]-[8]. However, the characteristics of edge devices, such as openness, dynamics, autonomy, and the lack of stable basic protection measures, result in the lack of necessary trust between devices. As a result, it is difficult for devices to resist unreliable fraud and services, the collaboration between devices is prone to problems, and considerable private data can become exposed [9], [10].

Establishing trust relationships between devices to detect untrusted entities can effectively eliminate malicious and selfish nodes, reduce the risk of independent decision-making, and improve system reliability [11]. Compared with the cloud computing environment, the traditional centralized

security mechanism is no longer suitable for the fully distributed edge computing architecture. The edge layer contains a large number of high-frequency interactive devices, and the number of nodes and trust information is growing exponentially. While edge layer devices are mostly resource-constrained devices, massive trust information easily leads to information overload, causing node overload and early decline [12]-[14]. A trusted and lightweight distributed trust evaluation mechanism is urgently needed. Therefore, the trust model in the edge computing environment has gradually become a research hotspot.

In the face of limited resources and open edge computing, many experts and scholars have adopted different methods for building trust evaluation models for edge computing environments[15]-[18]. In addition to the evaluation model based on subjective logic, Dempster-Shafer evidence theory, Bayesian networks and other trust evaluation models, there are also models based on recommendation node similarity, scoring deviation mixed methods, multiattribute evaluation, and so on. Next, we will discuss the following three aspects:

In terms of improving effectiveness, Deng *et al* [19] proposed a multiobjective optimization and collaboration scheme based on comprehensive trust, which optimized the

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