Poster Abstract: Access Point Ranking for Cloudlet Placement in Edge Computing Environment

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***Abstract*—This poster addresses the problem of access point ranking for cloudlet placement in edge computing environment. Access point ranking is an important step for cloudlets placement. Currently, there is no method that can rank the access point effectively for ignoring the connection features of the access points. To address the problem, we propose an adaptive and comprehensive access point ranking method by investigating the connection features of the access points. We introduce the system model and the technical detail of the proposed access point ranking method in this paper. The experimental results validate the effectiveness of our proposed access point ranking method.**

Keywords—edge computing; mobile computing; cloudlet placement; access point ranking

I. INTRODUCTION

Recently, mobile applications are becoming increasingly computational-intensive [1]. Due to the size, weight, and battery life of mobile devices, the computing capacity of mobile devices is limited [2]. Edge computing [3] is emerging as a platform to provide rich computing resources for mobile devices. In edge computing, the cloudlets are placed to co-locate with access points in a wireless network. The number of cloudlets to be placed is much smaller than the number of access point. There are a large amount of access points in a wireless metropolitan area network. Therefore, how to place the cloudlets becomes a great challenge.

There is no method currently that solves the problem effectively for ignoring the connection features of the access points. For example, suppose there are only one cloudlet placed in the wireless metropolitan area network. If the there is only one link that connects to the co-located access point, the mobile data from a large amount of mobile applications may congest the link. In addition, the cloudlet becomes inaccessible if a link failure event occurs.

To address the above mentioned problem, we propose an access point ranking method for cloudlet placement by investigating the connection features of the access points. The proposed method can adaptively and comprehensively rank the access points based on the connection features. The ranking results can provide reference for cloudlet placement. The experimental results validate the effectiveness of our access point ranking method (APR).

We introduce the system model and the technical detail of the proposed access point ranking method in Section 2 and Section 3 respectively. Section 4 evaluates the performance of the proposed method. Section 5 concludes the paper.

II. SYSTEM MODEL

As shown in Fig.1, the wireless metropolitan area network consists of many access point at various locations. The network can be represented by an undirected graph $G = \{V, E\}$. The mobile users connect to the network through the wireless links. The access points connect to each other through wired links. There are several cloudlets to be placed. The cloudlets should be co-located with the access points. Taking the connection features of the access points into consideration, the access points are arranged by descending order according to the appropriateness for cloudlet placement.

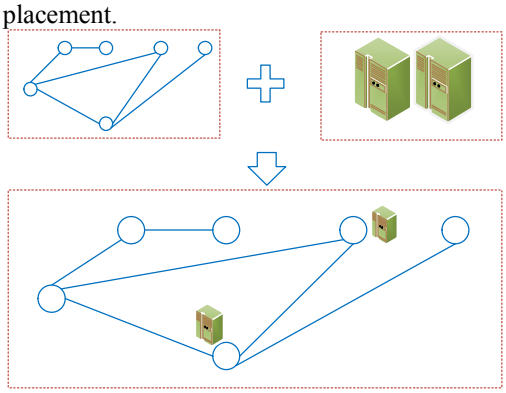

Fig. 1. System model.

III. PROPOSED METHOD

A. Access Point Importance Indicator Selection

The connection feature of each access point can be evaluated by the following indicators:

- Degree Centrality (*DC*) [4] is the ratio of the number of real edges to the maximum number of possible edges associated with a specific access point.
- Closeness Centrality (CC) [5] is defined as the average distance from a specific access point to all

other access points in the wireless metropolitan area network.

- Betweenness Centrality (BC) [6] evaluates the importance of an access point based on the average shortest path.
- Improved K-shell Decomposition (IK) [7] identifies the position of an access point in the wireless metropolitan area network by removing the access point associated with it step by step from the outermost layer.

B. Data Collection and Normalization

The attribute data of all access points are collected. Because the various attribute data have different dimensions and scales, data normalization should be done before access point ranking. Min-max normalization is adopted to normalize all data. Each attribute data is normalized by the following:

$$n(c_I^i) = \frac{c_I^i - \min_I}{\max_I - \min_I} \tag{1}$$

where i denotes the *i-th* access point, I belongs to $API=\{DC, CC, BC, IK\}$.

C. Weights Calculation

The weights of the four indicators are adaptively calculated based on the information theory [8]. The weight of each indicator is calculated by the following:

$$p_I^i = \frac{n(c_I^i)}{\sum_{i=1}^{|V|} n(c_I^i)} \tag{2}$$

$$e_I = \frac{-\sum_{i=1}^{|V|} p_I^i \ln p_I^i}{\ln |V|} \tag{3}$$

$$w_I = \frac{1 - e_I}{4 - \sum_{API} e_I} \tag{4}$$

where I belongs to $API=\{DC, CC, BC, IK\}$.

D. Access Point Ranking

Based on the connection features of the access points, the importance of an access point V_i can be calculated by the following:

$$r_{Vi} = w_{DC} * c_{DC}^i + w_{CC} * c_{CC}^i + w_{BC} * c_{BC}^i + w_{IK} * c_{IK}^i \tag{5}$$

The access points are ranked based on r_{Vi}. The larger r_{Vi} is, the cloudlet is more suitable to be placed with the access point.

IV. Experiment

In our simulation, we construct a network based on the campus network of Beijing University of Posts and Telecommunications. The experiment is conducted on a PC with Intel Core i5-3470 3.2GHz CPU, 4GB RAM. We compare APR with RAN, which ranks the access points randomly. The methods are evaluated by the number of connected component (NCC) after an access point becomes inaccessible. The access point is destroyed one by one according to the ranking results. A larger NCC value indicates that the ranking strategy is better. As shown in Fig.2, our method outperforms the compared method.

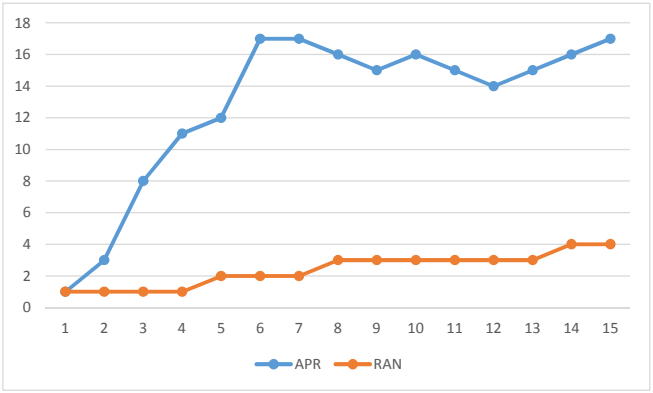

Fig. 2. Experiment result.

V. Conclusion

Edge computing is an important technology that can improve the performance of mobile applications. In this paper, we address the problem of access point ranking for cloudlet placement in edge computing environment. We investigate the connection features of the access points and propose a simple yet general method to adaptively and comprehensively rank the access points. The experimental results validate the effectiveness of the proposed method.

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