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Business Requirement-based 5G Slice Selection

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Abstract. The new generation of wireless communication not only to achieve the link between people, but also to achieve all things together and diversified business needs, but the traditional networks can't provide perfect service for a variety of business, the next generation of mobile network alliance to make use of virtualization technology slices the network, which is logically isolated to each other but shares the same physical infrastructure. And the slices are customized for specific on-demand, which makes the business need to select the appropriate slice to get good service. In this paper, a fuzzy matching algorithm based on service is proposed. The proposed scheme is compared with Max-RSRP (Reference Signal Receiving Power). The results show that the proposed algorithm can select the appropriate slices and reduce the number of handover times.

Keywords: 5G, selection, slice

1 Introduction

Communication network development has developed from analog communication to digital communication. According to statistics, mobile data traffic has reached 370 million bytes by the end of 2015, and expected mobile data traffic will be 8 times by 2020 [1]. There are many factors that contribute to this situation, but the diversity of mobile terminals and the innovation of mobile networks are the key factors in the explosive growth of mobile data traffic [2].

The future of the mobile network not only to serve the traditional business, such as ring up and computer games, but also need to provide different services to the business, such as vehicles, Virtual Reality. Future network architectures need to serve a wide variety of business, but if existing networks to provide satisfactory service to all business, the network will becomes particularly complex and difficult to maintain, and most of the services do not need such a complex network, this will cause unnecessary waste. The next generation mobile network alliance proposes to use the virtualization technology to slice the network, each of which is logically isolated but shared the same physical infrastructure. A network slice is a service that requires the same business, but the similar businesses may have different requirements, so slice can be made up of one or more sub-slices [3]. This requires that all wireless virtual networks need to meet two requirements, (i) different virtual networks can coexist in the same physical network (ii) virtual networks need to be isolated from each other in order to avoid conflicts created by coexist virtual networks [1]. Slices are fragments that divide the network into different resources and capacities, and can be customized in on-demand manner for specific businesses. Based on the slice technology of Network Function Virtualization (NFV) and Software Defined Network (SDN), it has great flexibility. Slicing operator can create or destroy slices as needed. Traditional networks can meet all users' requirements, and all businesses use the same metrics to judge the network. This makes it very different for the business in the slice to connect to the network with the traditional access, and the slice selection becomes particularly important.

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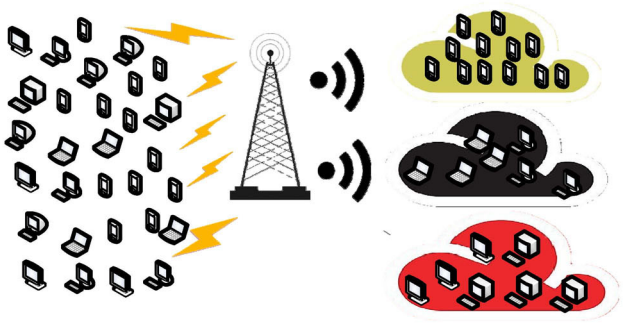

Fig. 1. 5G slice network model

Article [4] proposes a framework and the mechanism, make the Application Service Provider (ASP, Application Service Provider) can based on the service descriptor associated with the application (for example, high mobility or traditional streaming transmission, etc.) to provide slicing choose services. In [5], a service-based slice selection function is proposed. The eNB extracts the usage type and service type of the UE. The Domain Name System (DNS) queries the most suitable slices based on the information obtained. In [6], a cell selection strategy based on the system transmission power minimization is proposed. The algorithm selects the best service cell for the user through the convex optimization theory under the condition of satisfying the user's business demand from the energy efficiency point of view.

The composition of this paper is as follows, the second section will describe the system model. Section 3 will be based on business needs to switch the way. Section 4 will show the results of the performance evaluation of the proposed program. The last section is the conclusion.

2 System Model

This paper assumes a system model, which is a multi-cell system of 5G. The system exists N kinds of characteristics of different business, in order to ensure that every business can be allocated to a virtual slices, and don't let the system become complex, the number of slices in here is the minimum set that contains all the business. ITU-R (International Telecommunication Union Radio communication Bureau) determine the future of the 5G has the following three main application scenarios, Enhance Mobile Broadband (eMBB), Ultra Reliable & Low Latency Communication (uRLLC), and Massive Machine Type Communication (mMTC) [7], hence, here the slides is three, they are eMBB slide, uRLLC slide and mMTC slide, their covered range interlapped. Single user can insert a slide only at one moment, it may need to re-select slide when shift business (Fig. 2).

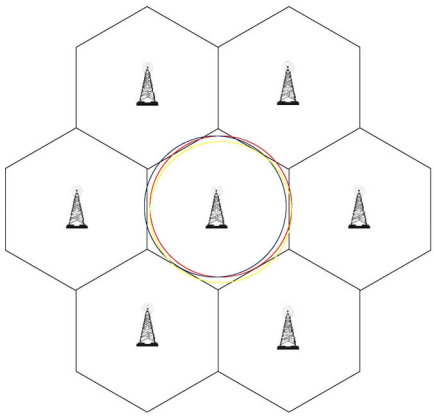

Fig. 2. System model

It needs to divide business to three groups according to key demand [8-9], set network's key ability according to business demand. Every slide is designed according to one kind of business, every slide has its own key performance, eMBB slide needs to provide service for high mobile service. uRLLC slide has

higher reliability which can guarantee tele-operation, telematics and others which has high requirement to reliability. mMTC slide has business of smart metering, which provide service for large -scaled internet off things application. Then all business assigned to three slices, such as smart meters, terminal is fixed, the data flow is smaller than mobile phone, delay constraint is very loose, but the number of connections is huge, so in the slice of Internet of things (IoT) requires that every square metre of km needs to connect at least hundreds of the number of connections, consideration is to switch, mobility and time delay function is relatively weaker. While remote surgery, unmanned services and other businesses have high reliability and security requirements, the most stringent capabilities of uRLLC sections are reliability and security, and other requirements can be relaxed.

When the terminal switched on or when the user reopens the business, need to select the slice. Here the slice selection is divided into two categories, one kind is the initial slice selection that is, the UE without any prior information, such UE will according to the characteristics of business needs and ability to search for the best quality of the slice, and resides. Another kind is based on a priori information of slice choice, UE has been stored in the slice of a priori information, UE will be filtered to the priori information, pick out in line with the business characteristics and requirements of slice to reside, if all the priori information can't meet the requirement of community, UE will re-launch the initial slice selection

3 Selection of Slices Based on Business Requirements

Different slice network has different capability, and we can't simply to evaluate a slice with good or bad, here will use the application of fuzzy logic to slice selection algorithm, in this scheme, first determine the user needs of the business, second collection section of the important indicators and blurred it, then the user and slice match each other, and finally select the most suitable slice (Fig. 3).

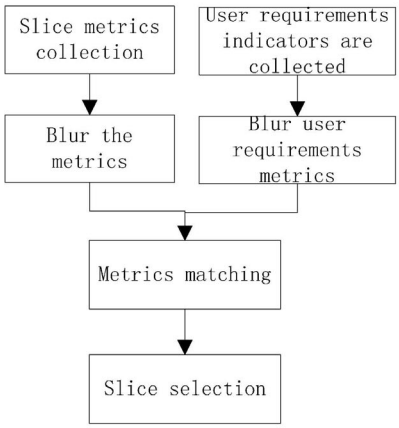

Fig. 3. Program flow

Need to collect the user and base station indicators are as follows, The data collected by the base station side are available: (1) slice load, the need to balance the amount of access; (2) SINR value, the higher the SINR value, indicating that the distance from the base station is more likely to be satisfied with the service; (3) delay, according to different business requirements for different delay; (4) data rate, some slices need; (5) reliability, some need to be highly reliable, such as remote surgery, vehicle communication; (6) slice can accommodate the number of this indicator for the mMTC extract, the The number of slices is different from that of other numbers. User side of the mobile phone data indicators: (1) slice load; (2) RSRP values; (3) delay; (4) data rate; (5) reliability; (6) slices can accommodate quantity requirements.

The data of the collected data are blurred. The data on the slice side: x_1 is the slice load, the load of the slice is given by $Ax_1 = \{\text{less, more}\}$, and the corresponding set of values is $Bx_1 = \{2,\ 1,0\}$. x_2 is the SINR value, RSRP values are similar to the fuzzy sets $Ax_2 = \{\text{large, medium, small}\}$, the corresponding numerical set is $Bx_2 = \{2,1,0\}$. x_3 is delay, the similar fuzzy sets of time delays are $Ax_3 = \{\text{low, medium, high}\}$, and the corresponding set of values is $Bx_3 = \{2,1,0\}$. The x_4 slice provides the data rate,

the similar fuzzy sets of data rates are $Ax_4 = \{\text{less, middle, multiple}\}$, and the corresponding set of values is $Bx_4 = \{2,1,0\}$. x_5 is the slice's reliability, the fuzzy sets with similar reliability are $Ax_5 = \{\text{high, medium, low}\}$, and the corresponding set of values is $Bx_5 = \{2,1,0\}$. x_6 is the slice that can hold the quantity, the slices can accommodate a similar number of fuzzy sets as $Ax_6 = \{\text{large, small}\}$, the corresponding set of values is $Bx_6 = \{5,0\}$.

Use x to indicate the slice side of the index, expressed as an array:

$$x = \{x_1, x_2, x_3, x_4, x_5, x_6\}^T$$

The data on the user side, y_1 is the user's requirement for slice load, y_2 is the RSRP value measured by the user, is the delay requirement of the user, the similarity of the fuzzy sets required for the delay is $Ay_3 = \{\text{low, medium, high}\}$, the corresponding set of values is $By_3 = \{2,1,0\}$ }; y_4 is the data rate required for the service, the similarity of the data rate requirements are similar to the fuzzy sets $Ay_4 = \{\text{large, medium, small}\}$, the corresponding set of values is $By_4 = \{2,1,0\}$; y_5 is the reliability of the service requirement, and the corresponding fuzzy sets of reliability requirements are $Ay_5 = \{\text{high, medium, low}\}$, the corresponding set of values for $By_5 = \{2,1,0\}$; and y_6 is the capacity of the service, the similar fuzzy sets with high slice capacity are set to $Ay_6 = \{\text{large, small}\}$, and the corresponding set of values is $By_6 = \{5,0\}$.

With y that the user side of the indicators, expressed as an array:

$$y = \{y_1, y_2, y_3, y_4, y_5, y_6\}$$

Match the result with z:

$$z\_(i,j)=y*x$$

$z_{i,j}$ expresses matching result of j slide in ith area, the large z is the higher matching with business will be, the smaller expresses the lower matching. Terminal will choose slide with high matching.

4 Simulation Results and Analysis

In order to verify the performance of the service-based fuzzy matching algorithm proposed in this paper, the algorithm is compared with the traditional Max-RSRP. The algorithm selects the RSRP based on the measured value of the UE. The simulation parameters are shown in Table 1.

Table 1. Simulation parameters

Parameter	value
Number of base stations	7
Cell radius	500
Base station total power	46dBm
Number of slices	3
Number of users	240
eMBB slicing business	1/12
uRLLC slicing business	1/12
mMTC Slice business	5/6
User distribution	Random points
Carrier frequency	2GHz
bandwidth	10MHz

Fig. 4 shows the average number of unnecessary switching times per user in the unit time, where we defined the switch as unnecessary switching without changing the business. It can be seen from the figure that the business requirement -based matching algorithm proposed in this paper switching times is less than the number of times of the Max-RSRP algorithm, and with the increase of the user, the scheme advantages is more obvious, because When the number of users increase based on Max - RSRP algorithm scheme will let a lot of IoT business access the other two conditions good slices, that will cause need low

latency high reliable high data volume business couldn't find the right slice.

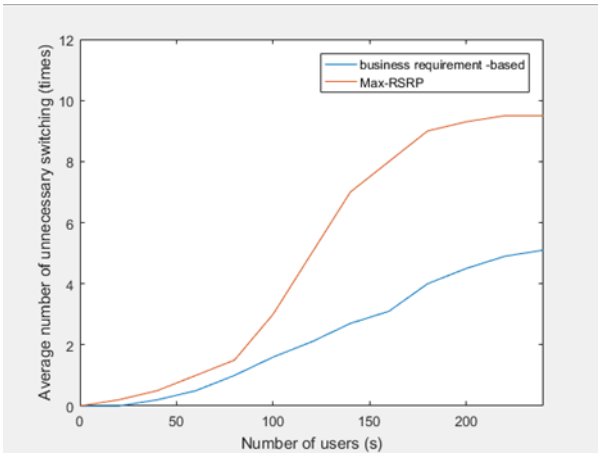

Fig. 4. Average unwanted number of times

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