A Lightweight Network Edge Service-Aware Method for Edge Networks

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Abstract. Edge computing is one of the main components of 5 g technology. It is used to adapt to the rapid development of the Internet of things and improve the service quality of the network. The combination of SDN and NFV can improve the flexibility of network service deployment. But at the edge of the network, the change of service will affect the quality of service. Therefore, we need a real-time business change perception system to provide differentiated services to improve the quality of different services. This paper proposes a lightweight service awareness technology based on network edge. This technology is based on the perception of mobile service flow in hierarchical echo state network (ESN). Traffic flow is sensed by discrete echo state network algorithm, and mobile resource scheduling and allocation ability are improved. Finally, the experimental results show that the proposed method can sense the services at the edge of the network, improve the capacity and bandwidth of the network, meet the differentiation of multiple services and QoS.

Keywords: Service-aware · Network edge · QoS · ESN

1 Introduction

With the development of Internet of Things, more and more services (such as vehicle communication, virtual reality, increased reality) and human interaction continue to arise, humans and environment, humans and machines have also gone through changes to the at the same time, more and more mobile devices and applications are used the fim to improve the user experience and ensure the quality of the network service, the edge computing scheme is proposed. This is also an important part of the fifth-generation network [1, 2]. NFV and SDN, as the key technologies of the 5 g network are more and more attention. Note that the NFV virtualization technology can be used simultaneously to provide flexible network services for all SDN network topologies and information e. Cross you are from the combination of the NFV and SDN commission, a new medium is provided all. Serving network connections. O number of users and devices accessing the

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network. If the broad server cannot provide matching network resources, the quality of network services will be reduced. In computing edges, users different types of network services for video transmission, virtual reality, increased reality, reality, e mail and online games, online medical training network service tem different requirements of network resources [3, 4]. Video transmission requires high speed and low delay data transmission, and virtual reality needs high-speed computing performance. How provide it on the net? Changing the characteristics of the real-time business on the network edge [4, 5], adjusting parameters to meet different business needs, and providing differentiated services became a theme.

Sensing technology is environmental conditions, customer behavior and movement of the object. This document is a method to explain the concept and context mechanism. Suggested. Wait. if the 5 g network satisfies the quality of service (QoS) in scenarios different. The reference [6] proposes a dynamic network system of wave resources, supporting services sensitive to a 5 g front delay end. The experimental results show that the system can effectively reduce delay in border [7]. This article proposes the dynamic composition of virtual services. According to the types of network services, summarize the types of different network services, define the characteristics of the use of network resources, and users need services to redevelop service types and propose corresponding solutions. The reference [8] proposed the network-based media framework. In order to achieve the traditional industrial hybrid router (using the OSPF protocol, etc.) And the switching network, it proposed the active control of network resources and the cooperation of multiple clients based on the flow of regenerative experience based on http [9], based on the SDN support (opening protocol, this paper proposes a smart transmission strategy based on QoS, a unique minimum price correction algorithm and a k-path targeting algorithm in industrial applications transmission system has improved.

Based on the way the change in service characteristics under the network edge can be felt in real time, this paper proposes a light network edge service sensing method before. This Method based on the echo state (ESN) mobile radio service influenza awareness mechanism. It uses discrete echo state network algorithm, to identify and perceive traffic flow in order to efficiently match network edge services to Research and development in the field of Top sensor technology. this basis will be the mobile resource allocation and allocation optimized. The fully utilizing the capacity and bandwidth of the technology also improves the ability to distinguish and support QoS from different services.

2 Hierarchical Echo State Network Classification Algorithm

2.1 Principles of Echo State Network

ESN algorithm is a new network algorithm Neural Recognition Model. It's a simplified form of recurring neural network (RNN). Compared to the traditional predictive algorithm of the coupling structure, HE HAS THE MOST FORTUNATIVE ABILITY NOT linear. Has Best non-linear dynamic performance simulation. ESN algorithm of the system is currently studying the most extensive and extensive neural network predictive algorithm, which is widely used in artificial intelligence field.

ESN uses a storage sphere composed of neurons randomly connected as a hidden layer and enters in a highly dimensional way and not linear. This It has nothing to do with the process of forming the Ecological State [10, 11]. It is a network, just one method linear. Practice the Reserve Bar Weight at the beginning ratio. East Method Simplifies the process of networking formation and ensures overall optimization determined. it has good generalization capacity and prevents the problems of the traditional neural network training algorithm from being complex and extremely local small. These advantages from autumn onwards there is great possibility of application in the state network Echo, control. Traffic. The typical structure of Echo State network is shown in Fig. 1. It consists of an input layer, core layer, and output layer.

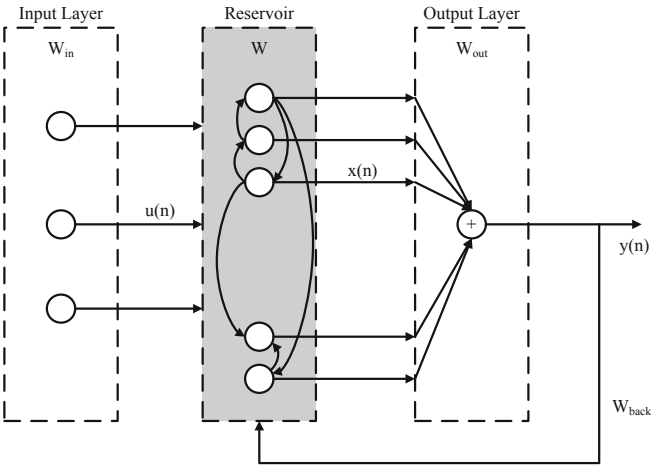

Fig. 1. Echo state network structure diagram

It is assumed that the echo state network consists of K input units, N standby pool processing units and N output units the basic equations of the echo state network are (1) and (2), where (1) is the status update equation of the internal neuron node, and (2) is the output forecast equation.

$$x(n+1) = f(W^{in}u(n+1) + Wx(n) + W^{back}y(n)) \tag{1}$$

$$y(n+1) = f^{out}(W^{out}u(n+1) + Wx(n+1) + W^{back}y(n)) \tag{2}$$

Where $u(n) = (u_1(n), \cdots, u_K(n))^T$ is the input variable of ESN, $x(n) = (x_1(n), \cdots, x_N(n))^T$ is the internal state variable, and $y(n) = (y_1(n), \cdots, y_L(n))^T$ is the output variable. The main parameters are: input connection weight W^{in}, N, x, K; intermediate weight connection matrix $W, N, x, (K + N)$; output weight connection matrix $W^{out}, L, x, (K + N + L)$; feedback weight connection matrix W^{back}, N, x, L; input is represented by u, DR dynamic pool is represented by x, output is used y said. In addition, f and f^{out} in the ESN model can be considered as stimulating functions of

the processing unit and the output unit. It is usually a sigmoid function, expressed as follows:

$$f(x) = \frac{e^{x} - e^{-x}}{e^{x} + e^{-x}} \tag{3}$$

The echo state refers to the internal state of the ESN, which is a limited function of the historical data input, i.e. "echo" of the historical Data entry. To ensure that ESN has echo status characteristics; when initializing structure W, the spectral radius of W should be less than 1 be. The main advantage of the neural ESN network is, the training method is simple and the dynamic pool structure is a simple random connection In the ESN training, the sample data stimulate the processing unit of the core layer by randomly generated weight matrix W^{in} and W^{back}. After each training round, the internal parameters of the ESN can be changed by linear regression to change the mean square error. The Input variables are connected to the processing unit from ESN to W^{in}, W^{back} is the connecting weight between the starting layer and the core layer, and W^{out} is the connecting weight between the core and the starting layer. In the training process the internal state weight matrix of the dynamic pool remains unchanged, only the connecting weight matrix W^{out} from dynamic pool to output is updated and the minimum mean square error nrmse calculated. In addition, W^{in}, W and W^{back} is generally set as a constant, and W^{out} can be achieved by certain training.

The mathematical expression of mean square error NRMSE is shown in (4):

$$MSE_{\min} = \frac{1}{T - T_c} \sqrt{\sum_{n=T_c}^{T} (d(n) - y(n))^2} \tag{4}$$

when NRMSE is minimum, use the offline generalized inverse matrix to calculate W^{out}, i.e. $W^{out} = M^{-1}T$, where $M = (x(n))$, $T = (d(n))$. When the W^{out} calculation is complete, you can start predicting the data.

2.2 Echo State Network Classification Algorithm

The basic principle of the classification of the acoustic state is represented in Eq. (5) in which $(n + 1)$ represents only different samples, not time. In the classification must remain unchanged until the value of the status variable of the reserve pool is stable; so that the difference between the results of the two iterations is minimal.

$$\begin{cases} x(n+1)^{(i)} = W^{in}u(n+1) + Wx(n+1)^{i-1} \\ x(n+1)^{(0)} = 0 \end{cases} \tag{5}$$

The advantage of the algorithm is that it stabilizes the status variables only by the activation function of the reserve building processing unit prior to processing and preserves the simple characteristics of the echo state network training [10], reduces complexity and ensures the overall optimal performance of operating results.

3 Business Perception Based on Hierarchical Echo State Network Algorithm

3.1 Principle of Business Classification Perception Based on Hierarchical ESN

In order to further improve service awareness, this paper proposes a service awareness algorithm, based on a hierarchical echo state network based. Service Perception Based on the hierarchical ESN algorithm is essentially the assignment of business properties to business types [12, 13], and its essence is the process the classification of decision-making fees (business types) based on conditional attributes (business characteristics).

According to the architecture of the network border system, a hierarchical ESN model The Commission hierarchical ESN model is divided into control layer, control layer and agent layer (as shown in Fig. 2).

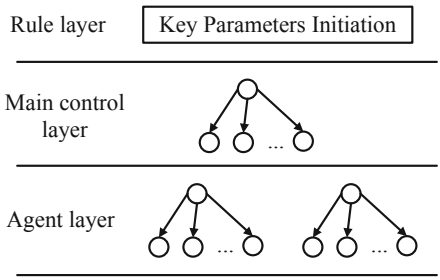

Fig. 2. Structure diagram of hierarchical ESN model

The main control consists of the ESN main control module and the Training module. The main control module introduces a large number of sample sets from the training module for a uniform ESN training up to the formation of a complete ESN classification. The training method used by ESN is the same as for the existing ESN- Training methods. the formation of the ESN Classifier, the main control module distributes the parameter information of the ESN Classifier to all.

The service perception process based on the hierarchical echo state network algorithm is divided into three parts: service feature parameter extraction, ESN training and ESN decision making [14]. The main characteristic parameters of the received two-way traffic flow, including frame length, service throughput time and service package flow interval, are considered traffic characteristics $u = \{u_1, u_2, \ldots, u_k, \ldots\}$. The auxiliary u of the traffic flow is entered into the trained echo state network model and the type of classification of the service is determined by calculating W^{out}.

3.2 Extraction and Preprocessing of Business Flow Feature Parameters

Both the main layer and the agent layer must have the characteristic parameters of the business process pre-processing [14, 15]. Before the main control must normalize the function parameters in the sample set and the agent layer must also normalize the function

parameters extracted from the incoming traffic flow The Pre-treatment is presented in formula (6).

$$\begin{cases} U(i) = (x_{i,1}, x_{i,2}, x_{i,3}, x_{i,4}) \\ x_{i,1} = \dfrac{P_{SIZE}(i)}{P_{SIZE\_MAX}} \quad x_{i,2} = \dfrac{P_{INTERVAL}(i)}{P_{INTERVAL\_MAX}} \\ x_{i,3} = \dfrac{P_{DUR}(i)}{P_{DUR\_MAX}} \quad x_{i,4} = \dfrac{P_{LOAD}(i)}{P_{LOAD\_MAX}} \end{cases} \tag{6}$$

where P_{SIZE_MAX} is the maximum packet length of statistics, $P_{INTERVAL\_MAX}$ is the maximum arrival interval, P_{DUR_MAX} is he maximum service duration, and P_{LOAD_MAX} is the maximum load rate of network cell nodes.

Before the training, the main control layer produces the traffic flow characteristics are provided for in the training sample according to formula (6). In the agent layer processes each Bayesian agent module the extracted traffic flow characteristic data according to formula (6) prior to the ESN classification operation, so that the ESN classification can calculate priority type of traffic flow.

3.3 Implementation of Business Awareness Mechanism

With a view to implementing the service awareness mechanism, this paper establishes a service awareness implementation system compatible with the network edge system architecture. The commission the master slave service awareness mechanism consists mainly of the master ESN module and each ESN module. The most important ESN module is for the first configuration of the ESN and training of the complex ESN responsible and transmits the parameter information of the trained ESN classification to each network unit. Each network unit configures the parameters of the ESN classifier and is independently responsible for the local service awareness function. The network unit extracts the parameters for the service flow.

In the main control layer, the ESN master module can use existing ESN training methods to form an ESN classifier. The ESN training shall be undefined to the terminal to ensure that all network elements of the system use the same ESN classifier, the consistency of service perception from a global perspective. In addition, the network node counts the records (including own values and classification results) of the traffic flow classification identification and periodically returns the records to the main control layer; to continuously add new training samples sets. The terminal Bayes main control module regularly trains the ESN after the test set to form a new ESN classification.

The function of the agent layer is realized by ESN proxy module, which running in the network unit device. The business flow perception can be divided into three processes: business flow feature extraction, ESN classification operation, and priority queue scheduling. Save Implement the information parameters of the ESN classifier emitted by the terminal and consolidate the ESN classifier internally via the Hardware. The “ESN agent module” extracts the characteristic parameters for each traffic flow and normalizes in order to avoid over-adaptation, so that the feature set describing the traffic flow receives and then enters the ESN classification to obtain the classification result, namely the priority of the traffic flow.

4 Simulation Result and Analysis

In order to check the proposed mechanism, a simulation system based on NS2 simulation software will be installed at the edge of the network. The simulation system consists of 32-network elements installed on the terminal. The SDN network is designed and the edge nodes are added. It shall be examined: whether the proposed service awareness technology achieves satisfactory results at the edge of the network can. By the simulation becomes the network edge with service award mechanism without service awareness with the network edge compared. In the simulation will turn traffic types into package-loss-rate-sensitive service and time-delay-sensitive Service divided.

Figure 3 shows the relationship between the accuracy of service delivery and training time, which can see that with the increase in training time also the accuracy of the company's performance improves is. Full permanently trained echo state network algorithm can ensure the accuracy of the service classification.

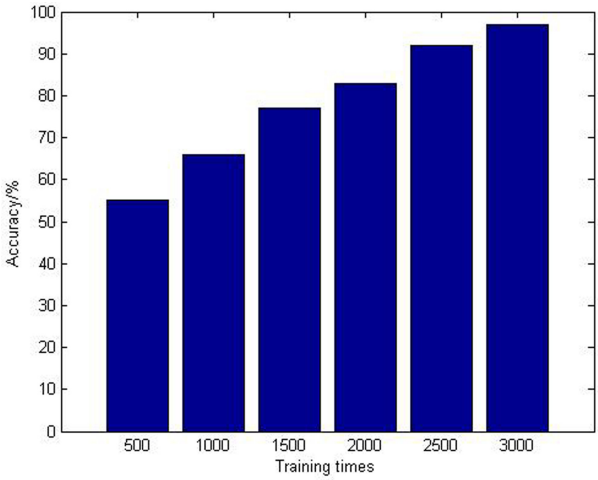

Fig. 3. Relationship between business perception ac-curacy and training times

In the edge network, this method (Service Awareness) and the traditional non-service-conscious mechanism for simulation used. Figure 4 and Fig. 5 are the results of Comparison. In Link to the simulation results of Fig. 4 and Fig. 5, with the increase in the net transport burden, the package loss rate and the real-time performance of the system we have designed tend to deteriorate. In the high load exceeds the traditional EPON system based on this mechanism in package losses and transmission processes Rounded. On the other hand, low priority services have lower requirements for transmission delays and package losses. The mechanism proposed in this paper will, to a certain extent, make the provision of services. In the exchange for the general quality of service, especially the QoS requirements of high quality services.

Comparison of package losses and delays shows that the proposed service sensing method can ensure the reconciliation of the different types and priorities of services on

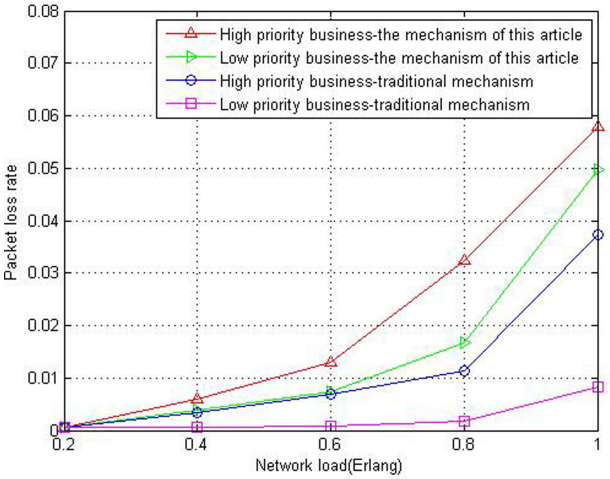

Fig. 4. Comparison of packet loss rate

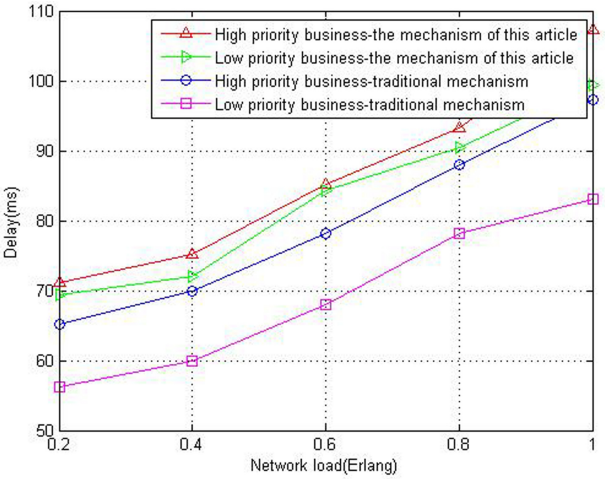

Fig. 5. Delay comparison

the periphery of the network with low computational complexity and ensure the overall quality of the service.

Figure 6 shows how the network block rate is changed when using different vertical transmission algorithms with different arrival rates changes. In Fig. 6, the arrival rate of users is very low and the network resources are sufficient to meet the needs of users, so that the lock rate is almost zero. With the continuous increase in the rate of arrival, however, increases the blocking rate, we can see that the lock rate of the algorithm proposed in this chapter is lower than that of the AHP-SAW and TOPSIS algorithms under the same rate of arrival of the users. This depends on that the algorithm in this

chapter sorts users according to the service type, if they want an exchange, and constructs different decision paths for different users of different service types, thereby avoiding the network overload caused by a large number of users, which switch simultaneously to the same network and effectively reduce network overload.

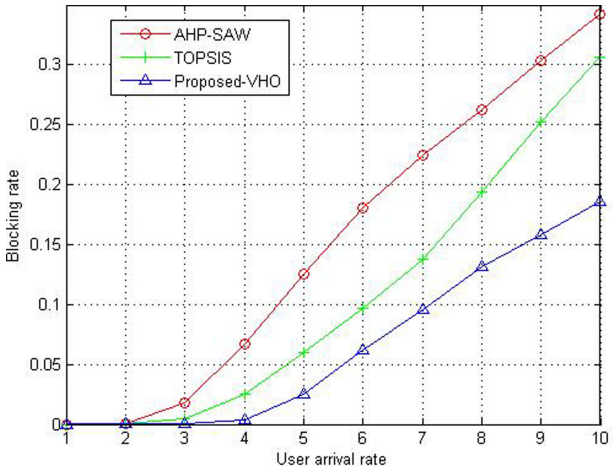

Fig. 6. Blocking rate change graph with user arrival rate

Finally, I would like to say that the proposed service awareness method can effectively improve the ability of the network edges to support multi-service differentiation, in particular to ensure the quality of the service with high real-time availability and high reliability.

5 Conclusion

The introduction of Edge Computing leads to the rise of High-end networks. The diversity and complexity of new services to. The Traditional service mode is increasingly difficult to adapt to the development trend of the service industry to adapt. There is an urgent need for more precise, medium complexity and simpler A sensor to solve these problems, this paper proposes a mobile service Influenza awareness mechanism, which will operate on a hierarchical echo-state network Based. Discrete Echo State Network algorithm is used to identify traffic flow and flush On the base Mobile Resource Mining and Allocation Options will be optimized and research on network edge technology Based on the planning and allocation functions of mobile resources will be based on an easy network edge service award process optimized. The Simulation results show, that this method also improves the ability to distinguish different services and support QoS.

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