

Jia LI, Ren-chao XIE, Tao HUANG, Li SUN, 2018. A novel forwarding and routing mechanism design in SDN-based NDN architecture, *Frontiers of Information Technology & Electronic Engineering*, 19(9):1135-1150.
<https://doi.org/10.1631/FITEE.1700698>

A novel forwarding and routing mechanism design in SDN-based NDN architecture

Key words: SDN-based NDN; Forwarding mechanism; QoS routing; Genetic algorithm

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Motivations

1. With explosively increasing multimedia services in network, it's complex and error-prone to solve the distribution problem in a host-centric network, along with the inherent problems in an IP network, such as security and exhausted naming space.
2. Combining NDN and SDN has been considered as an important trend, but the forwarding mechanism to solve the inherent problems caused by the flooding scheme and discard of Interest packets in traditional NDN is not well considered.
3. Existing works pay more attentions to the macro design of architecture, and the routing strategies carried out in controllers based on quality-of-service (QoS) are not much considered.

Main ideas

1. We design a novel forwarding mechanism in NDN architecture with distributed controllers, where routing decisions are globally made to solve the problems caused by random unicast strategy and a scheme of discard.
2. We propose a novel routing algorithm considering QoS applied in the proposed forwarding mechanism and carried out in controllers.

Method

1. We make some extension to the general SDN-based NDN architecture. And we design the data structures in the controller and router, thus the controller can maintain global information of the local and adjacent network. In addition, the router can record the configuration information from the controller.
2. We propose a novel forwarding mechanism based on SDN-based NDN architecture. In the mechanism, interest packets can be forwarded through an effective centralized routing strategy rather than being flooded and can all be matched to avoid needless abandonment and thus guarantee a higher response rate.

Method

3. We propose a QoS multi-constrained routing algorithm applied in the proposed forwarding mechanism with consideration of both resource consumption and network load balancing based on an improved GA algorithm, which is carried out in the controllers to make routing decisions during packet forwarding.

Major results

1. The proposed routing algorithm can realize lower resource consumption than other two schemes.

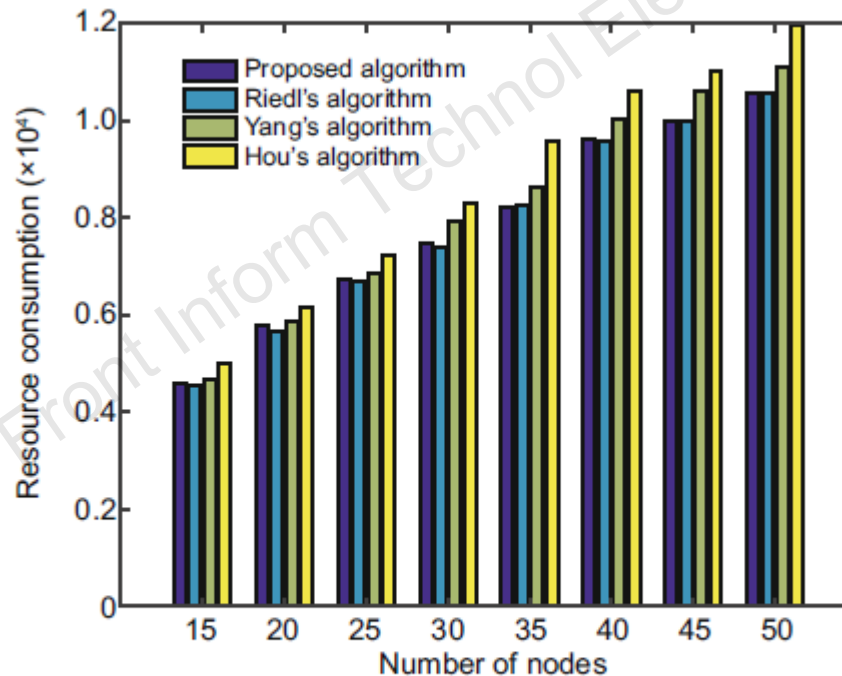


Fig. 15 Resource consumption versus the number of nodes with four algorithms

Major results

2. The proposed routing algorithm can realize better load balancing, i.e., lower variance of load distribution than the other four algorithms.

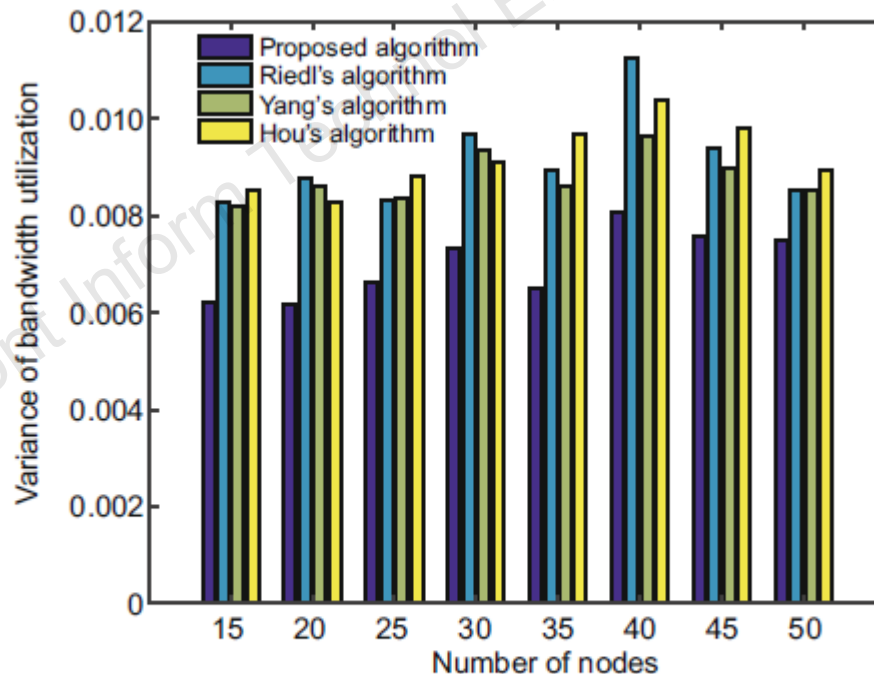


Fig. 16 Variance of bandwidth utilization versus the number of nodes with four algorithms

Conclusions

1. We have proposed an extension to the general SDN-based NDN architecture in reference to distributed controllers in the SDN.
2. We have proposed a novel forwarding mechanism to solve the information redundancy caused by the flooding strategy in traditional NDN networks.
3. We have proposed a global QoS routing algorithm executed in the controller based on the proposed forwarding mechanism, considering both resource consumption and load balancing of the network, and calculated by a modified GA.
4. Simulation results have been presented to show that our proposed QoS routing algorithm can find a path with low resource consumption and great load balancing. In addition, the GA has a better performance than three other algorithms.