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Keio University

Thesis Abstract

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Thesis Title

A Study on Distributed Management Schemes for Node Mobility in the Internet

Thesis Summary

This thesis introduces a comprehensive study carried out focusing on Mobility Management (MM) schemes in the Internet. It describes the evaluation procedure adopted along with the simulator which is constructed to support the evaluation. Then, the results obtained are explained, which lead to introduce a novel MM scheme.

During the past couple of decades, there have been a considerable number of standardization efforts for MM in the Internet. However, those standard methods severely suffer from well-known problems. Those problems include a single point of failure and attack, non-optimal data routing, and restricted scalability. Even though there has been a significant amount of efforts which try to identify such major problems and fix them by adopting a Distributed MM (DMM) approach, those efforts are still in the proposal phase.

Performance evaluation of MM protocols remains challenging, despite of having a handful of network simulators. These simulators provide least conveniences to build and evaluate new protocols, regardless of having a good set of facilities to simulate ordinary standard protocols. Especially, it is difficult to simulate relatively new concepts, such as DMM. Thus, it remains extremely strenuous to evaluate proposed schemes and identify their competencies and applicability.

Motivated by the lack of performance evaluation efforts and lack of simulation support, an Internet Protocol (IP) mobility simulator called SimNetDMM was designed considering the network layer of the Internet. It attempts to simulate mobility scenarios over mapped and synthetic topologies for all the selected MM schemes. SimNetDMM can be regarded as the inceptive effort of that sort. It also allows realistic mobility patterns, MM entity installments, and routing policies. Thus, the results can be considered closely liable and realistic.

The selected set of client driven (host-based) and network driven (network-based) MM schemes are evaluated for performance separately. Evaluation carried out for host-based MM schemes reveals that the fully distribution in the control-plane in terms of functionality retrieves better control-plane performance. On the other hand, better performance in data-plane is observed during the evaluation for network-based DMM schemes with control/data-plane split. Thus, in overall, fully functional distribution in the control plane and control/data-plane split are identified as candidate MM approaches. Disadvantages of the existing proposals focusing on these concepts are also identified. A fully distributed host-based MM scheme found in the literature lacks consistency. The scheme adopting control/data-plane split has poor control-plane performance and when employed in a distributed control-plane environment, it suffers from heavy control overhead due to data residency.

Considering the above issues, a novel localized network-based fully-distributed MM scheme (DMMSDN) is introduced. It is designated for a distributed Software Defined Network (SDN) environment. Control/data-plane separation is achieved with SDN. Dynamic Host Configuration Protocol for IPv6 (DHCPv6) is adopted for accounting and assigning IPv6 addresses for Mobile Nodes (MNs). DMMSDN distributes the control plane reducing data redundancy and increasing consistency of MM. Further, it regulates flow table updates in SDN to reduce control-plane overhead. The size of memory required in SDN-controllers is minimized by limiting MN’s mobility information to be stored only in a single SDN-controller called the initial SDN-controller.

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DMMSDN is simulated and evaluated against a few DMM schemes. The results confirm the applicability of DMMSDN. Further, multiple SDN-controller installment is also examined. Optimal SDN-controller installments are identified for different topologies. Highest distribution in the control-plane is better for larger Internet Service Provider (ISP) networks residing closer to the Internet core (tier-1), which cover a few continents and have a considerably large number of Access Routers (ARs) for MNs. Medium distribution is better for least distributed ISP topologies residing at the edge of the Internet (tier-3). Least distribution is better for medium ISP topologies (tier-2).

They are tend to lease Internet Access to edge ISPs rather than providing direct access to MNs. The results confirm that multiple SDN-controller installment always outperforms single SDN-controller installment. Further, control-plane results are stable despite of the intercommunication of SDN-controller set. Thus, it assures the admissibility of DMMSDN.