

**Achieving High Scalability Through Hybrid Switching in Software-Defined Networking**

**Abstract:**

Traditional networks rely on aggregate routing and decentralized control to achieve scalability. On the contrary, software-defined networks achieve near optimal network performance and policy-based management through per-flow routing and centralized control, which, however, face scalability challenge due to: 1) limited ternary content addressable memory and on-die memory for storing the forwarding table and 2) perflow communication/computation overhead at the controller. This paper presents a novel hybrid switching (HS) design, which integrates traditional switching and software-defined networking (SDN) switching for the purpose of achieving both scalability and optimal performance. We show that the integration also leads to unexpected benefits of making both types of switching more efficient under the hybrid design. We also design the general optimization framework via HS and propose an approximation algorithm for load-balancing optimization as a case study. Testing and numerical evaluation demonstrate the superior performance of HS when comparing with the state-of-the-art SDN design.

**Existing System:**

If traditional aggregate routing and decentralized control help scalability while SDN helps performance with centralized control, our idea is to integrate them for hybrid switching, which achieves the benefits of both worlds and is not subject to the restriction of TCAM. But wildcard rules can only be implemented through TCAM (Ternary Content Addressable Memory), which is small, costly and energy-hungry. The small number of wildcard rules may result in aggressive aggregation when facing a large number of excess flows, whereas the benefits of SDN rest upon its ability of differentiating arbitrary individual flows. Moreover, there is a lack of systematic studies on how to construct and manage optimal wildcard rules in a dynamic, heavily loaded network, which is a challenging problem. Therefore, alternative or complementary solutions to the scalability problem are under call.

**Proposed System:**

This paper presents a novel hybrid switching design. On the one hand, it leverages the mature methods of traditional switching to achieve scalability by avoiding per-flow communication/computation overhead to the controller and reducing the number of forwarding rules needed to support a large number of flows. On the other hand, it exploits the flexibility of SDN switching to achieve near optimal network performance without overflowing the forwarding table. More interestingly, we show that the integration of traditional switching and SDN switching brings unexpected benefits to each other. The SDN’s centralized control will help implement traditional switching much more efficiently. It can also centrally integrate the management/security policy requirements into the computation of traditional switching/ routing tables so that the paths comply with the policies. In the meanwhile, with a hybrid deployment design, we show that traditional aggregate routing will help to greatly reduce the overhead of deploying SDN paths by significantly reducing the number of forwarding rules needed. We also discuss how to perform per-flow traffic measurement without using the OpenFlow counters in the forwarding table, which is important in our hybrid switching design where many (or even most) flows are not in the table.