Paper Evaluation, Header Space Analysis: Static Checking For Networks

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1. Paper summary

The paper is focusing on the problem of the largely growing number of protocols in today's typical network and the failures that arise from the complex interactions of protocols. Switches and routers can't simultaneously handle these encapsulation formats, and it's really hard for operators to manage and introduce new protocols. Therefore, the authors tried to find a class of failures for networks, regardless of the protocols running. The key idea behind this approach is a generalization of the geometric way to packet classification rules over K packet fields which are viewed as subspace in a K dimensional space. More detail about it is that they represent each packet by a point in $\{0,1\}^L$ space, the Header Space, and use box transfer functions to transform subspaces of the L-dimensional space to other subspace. They use a network transfer function and a topology transfer function to model a network of boxes, so the overall behavior of the network is modeled as a black box.

2. Top 3 contributions

1. The first paper to map packet headers to an n-dimensional space, and it transforms the headers using individual network elements' transfer functions as the packets are being routed through the network.

2. Make it possible to detect the forwarding and configuration caused errors like loops in complex multiple-protocols networks. HAS can determine all packet headers that are in infinite and generic loops which can greatly save the resources of networks.

3. Offer the function to check the slice isolation and detect when slices are leaking traffic. This functionality makes it easy for network operators to control specific groups of hosts and elements. Also, it is useful for security which is very important in today's networks.

3. Problems

1. It only tests in a small backbone network which may not as complex as large typical networks. The performance of HSA in practical networks is unknown.

2. The HSA can detect a routing algorithm is broken, but it doesn't tell the reason. It offers no clues for failures.

3. As the authors said, HSA play a similar role in networks as post-layout verification tools do in chip design, or static analysis checkers do in compilation. It checks the low level output against a set of universal invariants without understanding the intent or aspirations of the protocol designer. So, it needs other approaches to analyze protocol correctness.