Goals

- Statically check networks to:
  - Detect failures such as Forwarding Loops and Reachability Failures.
  - Ensure Isolation of Slices created on a network.
  - Create a set of test packets for Runtime Self-Testing of networks to detect problems such as Link Failure, Congestion or Security Holes.

Method: Header Space Analysis

**STEP 1**
Model packet header as a point in \( \{0,1\}^L \) space

**STEP 2**
Add a unique port id as an extra dimension to the space

**STEP 3**
Model each box as transformer of network space

Two Examples

**Reachability**
Calculating Reachability:
- Method 1) Compose transfer functions along the paths that connect A to B
- Method 2) Inject an all-x packet from A and follow the packet until it reaches B

**Runtime Self-Testing**
Goal: Pick a set of test packets and injection ports to exercise maximum number of possible rules in the network.
Method:
- Find the all-way reachability from every available terminal port.
- Keep track of the transfer function rules that each flow exercises along the paths.
- Pick a set of flows and one representative packet from each flow to cover maximum number of rules.

What can be detected?
- Link or port down.
- Performance degradation such as congestion.
- Routing errors.
- Security holes.