Software Defined Networking

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In this course, you will learn about software defined networking and how it is changing the way communications networks are managed, maintained, and secured.

This Lesson: Slicing Network Control

- ◉ Overview of "network slicing"
  - What is slicing?
  - Why slice the network?
  - Flowspace and slicing policies
- ◉ FlowVisor: Virtualizing SDN Control
- ◉ Applications

Current Network Devices

Control Plane

- Computes forwarding rules
  - "128.8.128/16 --> port 6"
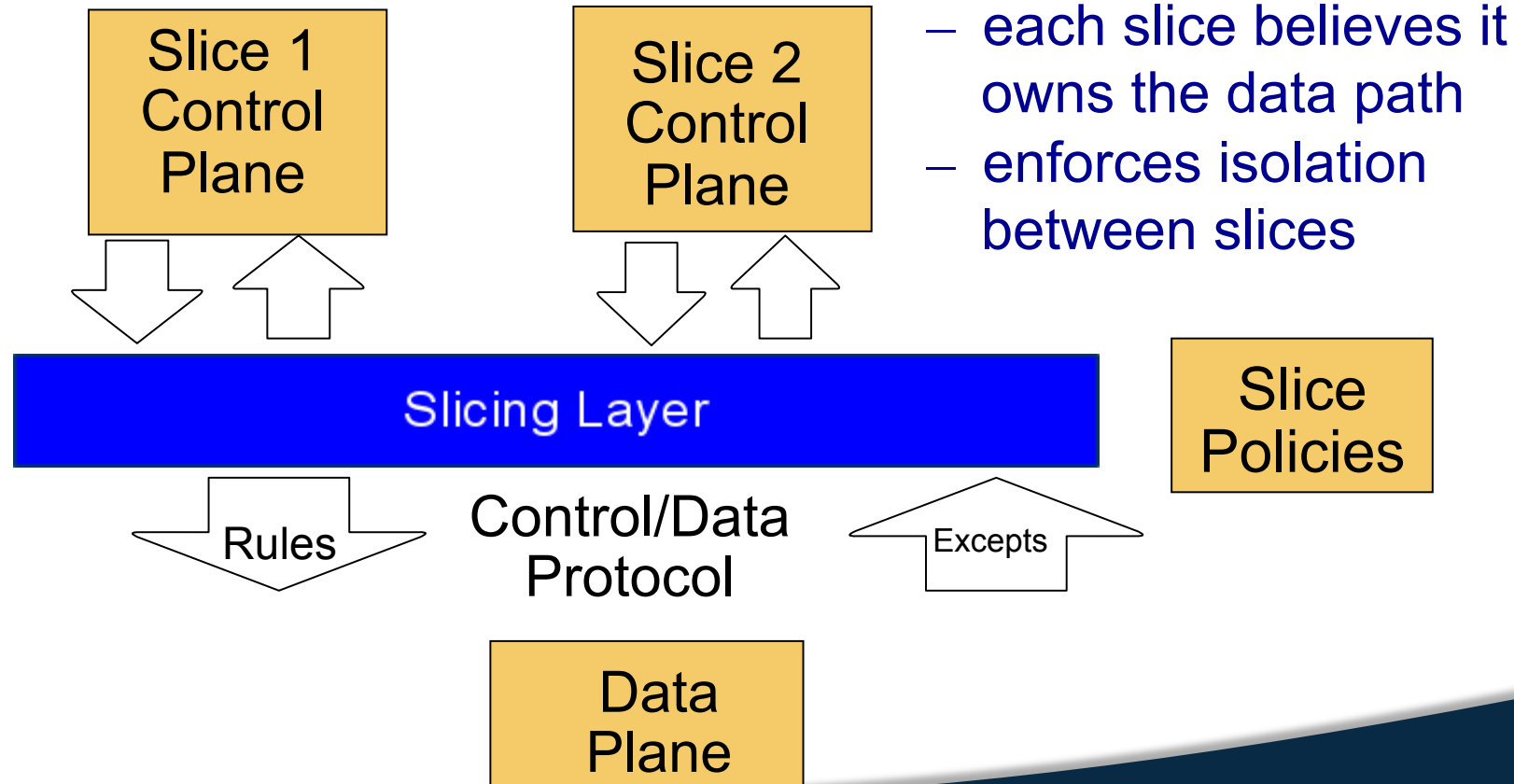- Pushes rules down to data plane

Rules

Control/Data Protocol

Excepts

Data Plane

- Enforces forwarding rules
- Exceptions pushed back to control plane

Add a Slicing Layer Between Planes

Slice 1 Control Plane	Slice 2 Control Plane	

- each slice believes it owns the data path
- enforces isolation between slices

Slicing Layer

Slice Policies

Rules → Control/Data Protocol ← Excepts

Data Plane

Network Slicing

- Divide the production network into logical slices
  - each slice controls its own packet forwarding
  - users pick which slice controls their traffic
  - existing production services run in own slice

- Enforce strong isolation between slices
  - actions in one slice do not affect another

- Each slice can mirror a production network
 - Production
  - Testing
  - Research

Why Slice the Network?

- ◉ Multiple administrative groups
  - Different departments on a campus
- ◉ Multiple customers
  - Tenants in a shared data center
  - Researchers on a shared infrastructure
- ◉ Experiments vs. operational network
  - Support research without breaking real services
- ◉ Expanding a network's footprint
  - Lease components in another carrier's network
- ◉ Multiple services or applications in one domain

Slicing: Forwarding and Policy

- Data plane unmodified (no performance penalty)

- Policy: Specifies resource limits for each slice
  - Link bandwidth
  - Maximum number of forwarding rules
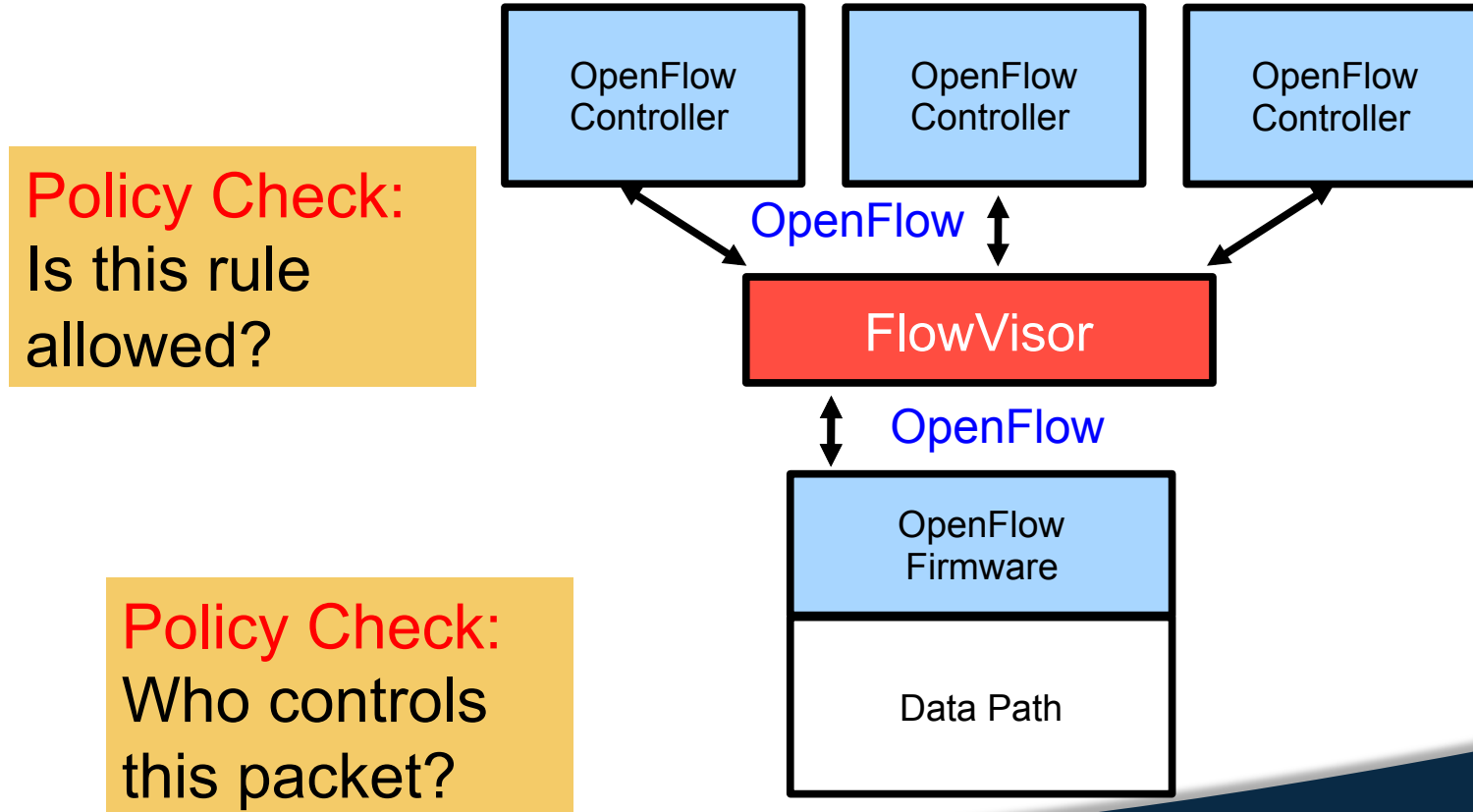 - Topology
  - Fraction of switch/router CPU

Flow Space:
Which Packets Does the Slice Control?
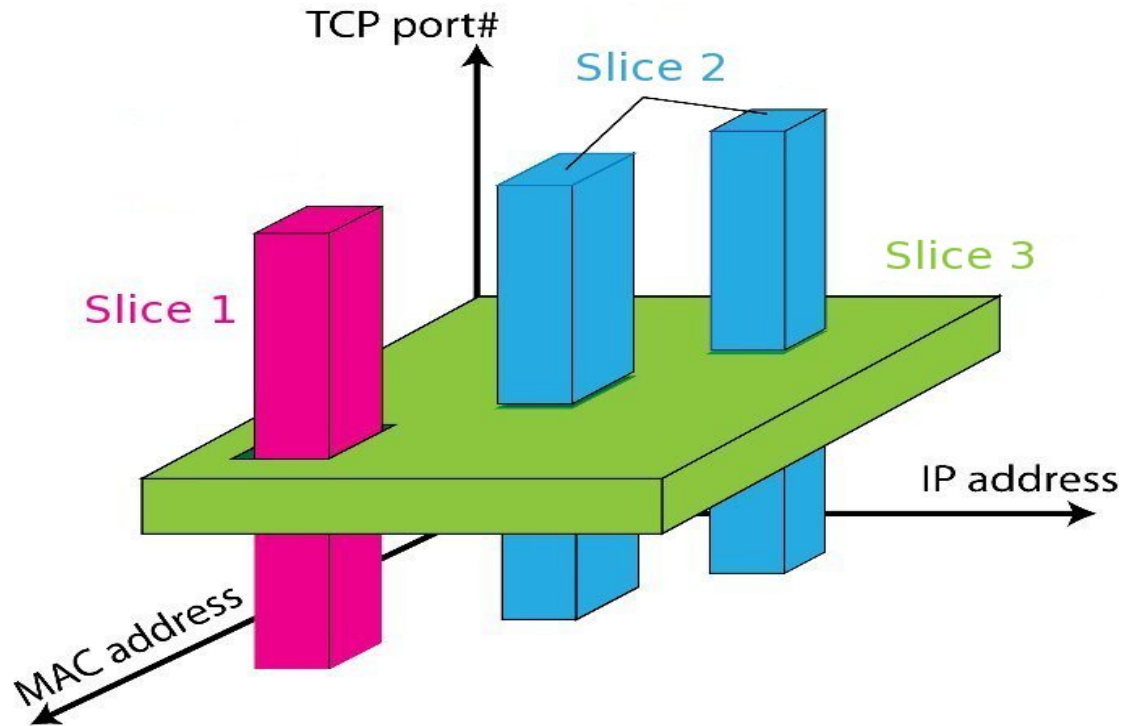
One Example: FlowVisor

⊙ **FlowVisor:** An OpenFlow controller that acts as a **transparent proxy** between OpenFlow switches and multiple OpenFlow controllers.

- **Slices:** any combination of switch ports (layer 1), src/dst ethernet address or type (layer 2), src/dst IP address or type (layer 3), and src/dst TCP/UDP port or ICMP code/type (layer 4).

⊙ Enforces isolation between each slice.

FlowVisor on OpenFlow

Policy Check: Is this rule allowed?

OpenFlow Controller

OpenFlow Controller

OpenFlow Controller

OpenFlow

FlowVisor

OpenFlow

OpenFlow Firmware

Data Path

Policy Check: Who controls this packet?

Examples: Ways to Slice the Network

- ◉ By switch port
  - • Basically the same functionality as VLANs
- ◉ By application (TCP port)
  - • Would require some more complicated access control lists
  - • Dynamism possibly a bit more difficult without SDN

Application: Testing

- ⊙ Connect fully operational networks that "mirror" the existing production topology

- ⊙ More realistic evaluation and testing

- ⊙ Same control software can be "migrated" to production

Application: Home Networks / IoT
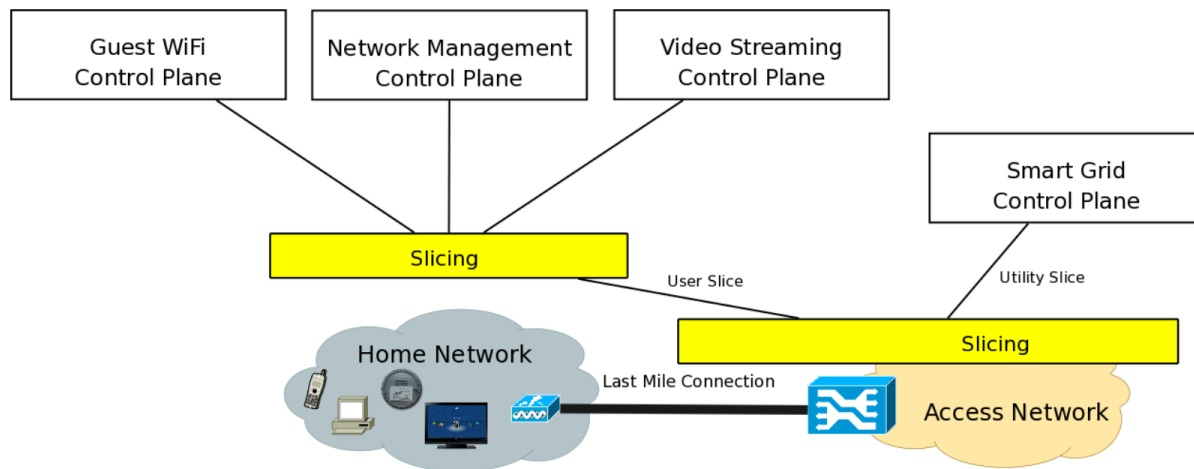
- ◉ Multiple service providers on a sliced home network
- ◉ Access network owner gives a slice of the last mile to the user, rents another one to utility company, etc.

Summary

- ⊙ Slicing the SDN control plane allows for
  - Multiple administrative entities
  - Pre-production testing (operations or research)
  - Sharing between multiple tenants
- ⊙ Slicing can be done by switch port, or any part of "flow space"
- ⊙ FlowVisor is one example of slicing SDN control