

Incremental SDN Deployment in Enterprise Networks

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with

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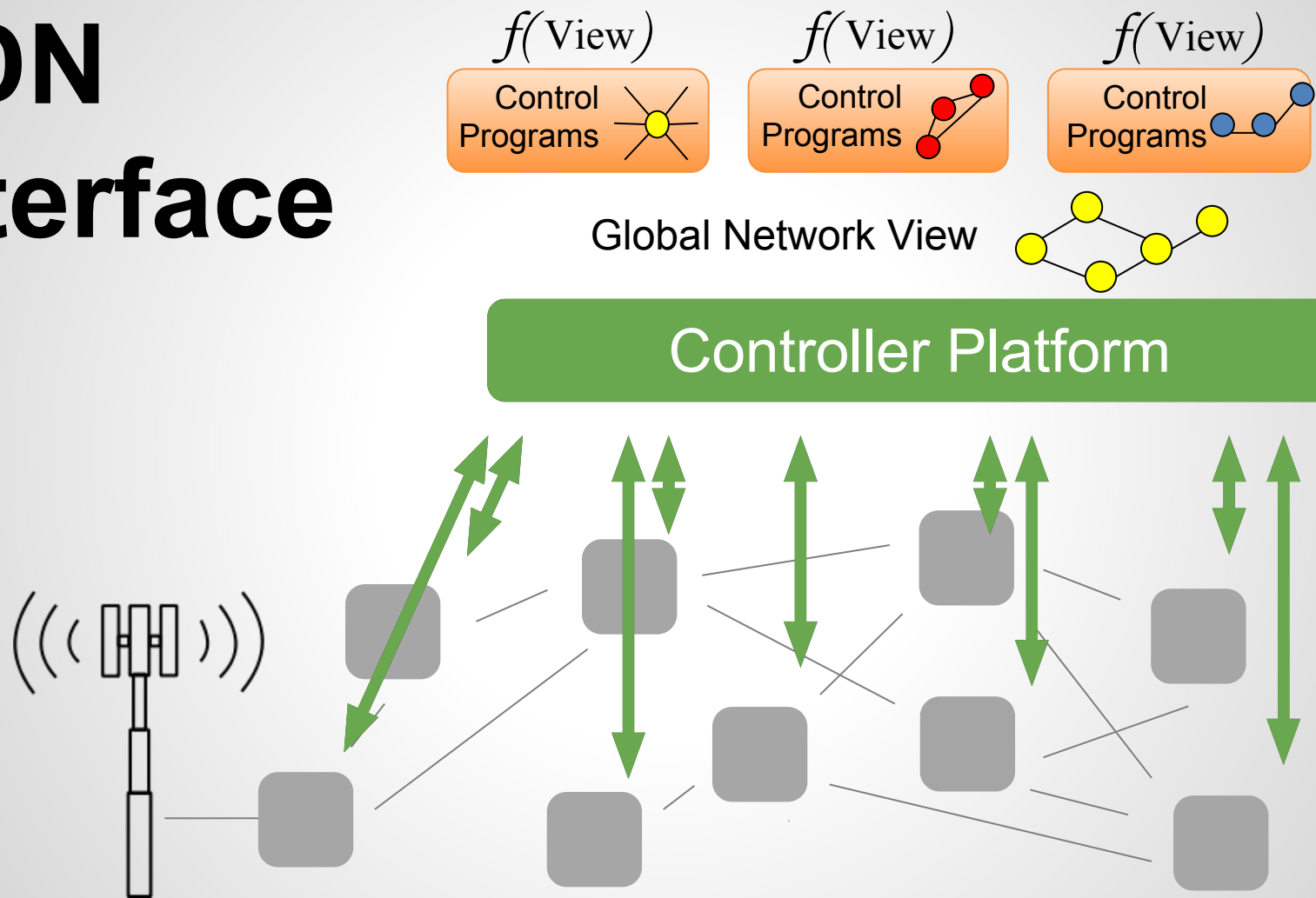
Telekom **Innovation** Laboratories



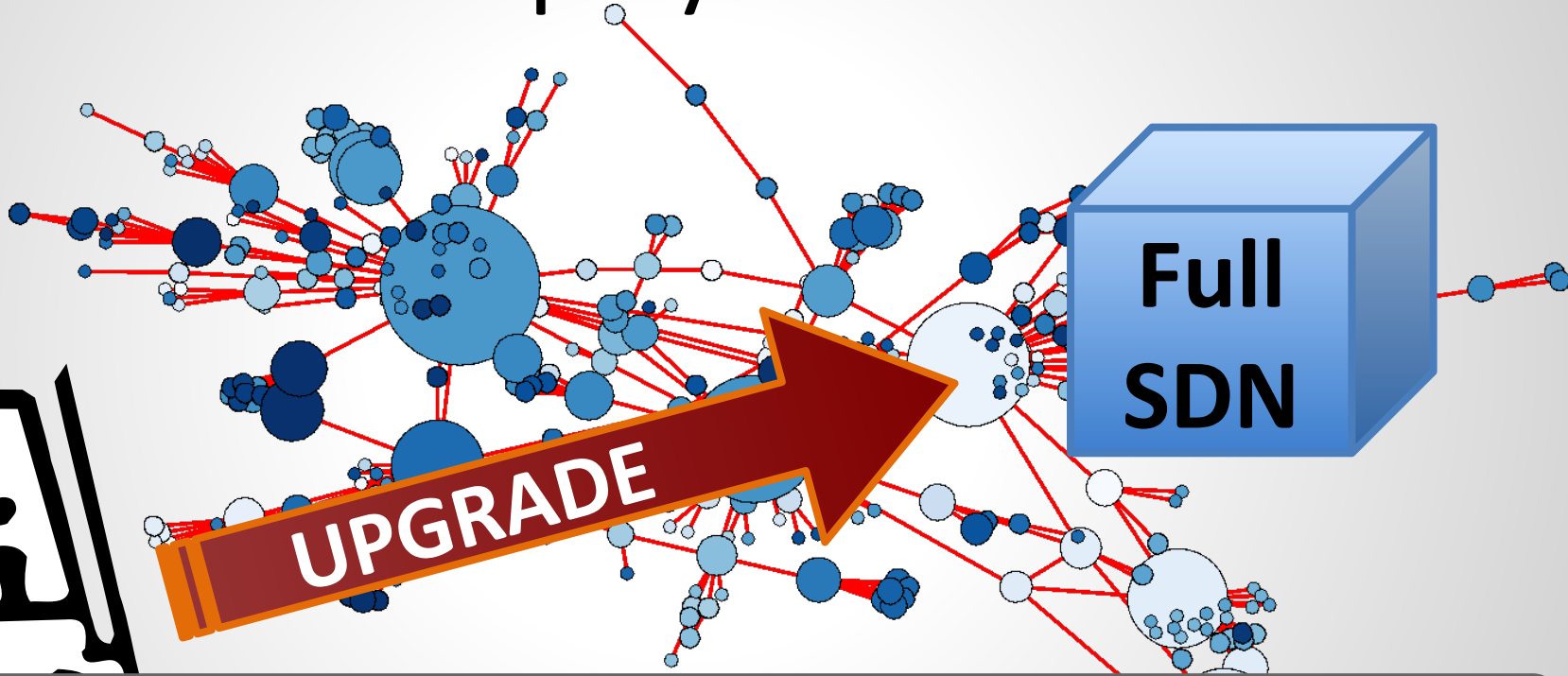
Motivation

- **SDN** deployments are emerging in the datacenter and WAN environments
- Can we get **benefits** of the **SDN interface**, deployed into more network environments?

SDN Interface



The SDN Deployment Problem

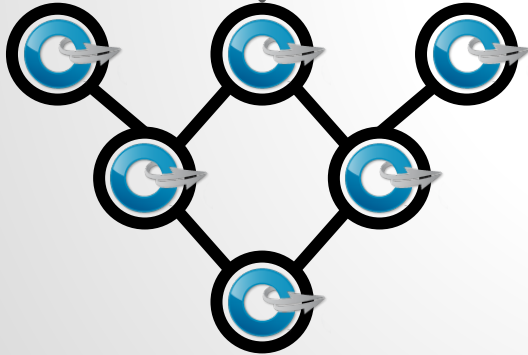
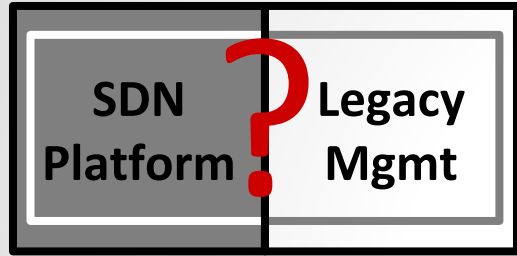


Must upgrade to SDN incrementally

Key Questions

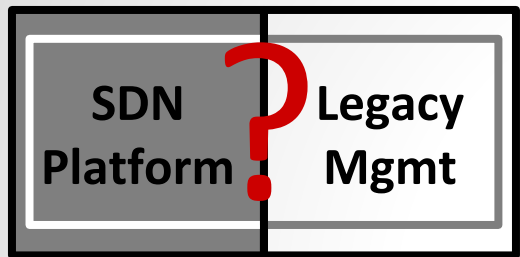
- How can we **incrementally deploy SDN** into enterprise campus networks?
- What **SDN benefits** can be realized in a hybrid deployment?

Current Transitional Networks

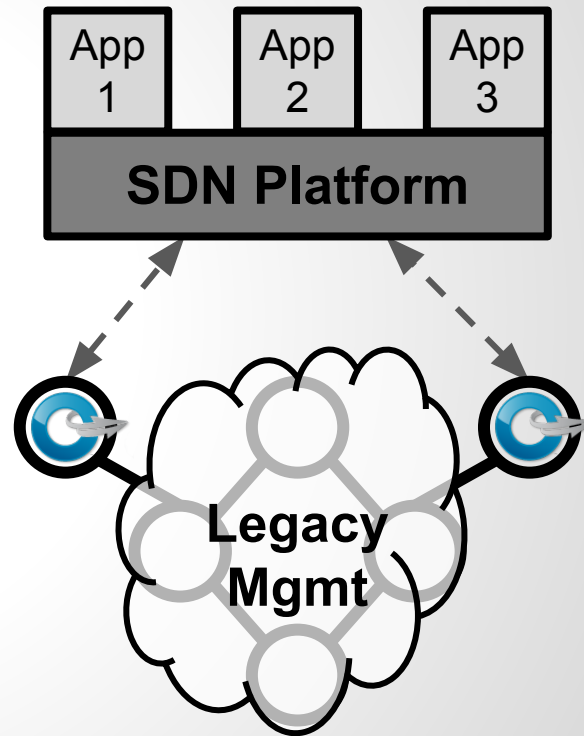


Dual-stack approach

Current Transitional Networks

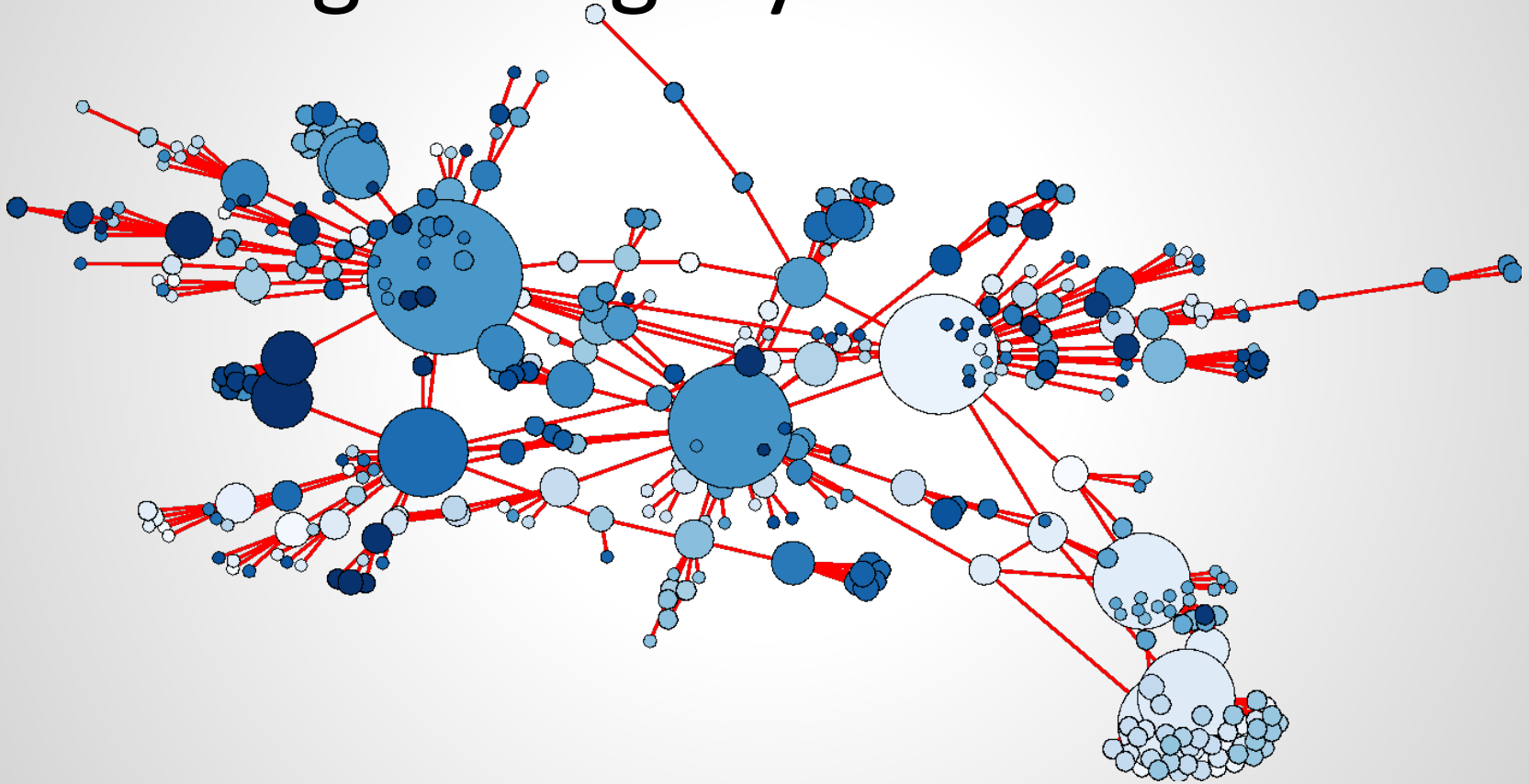


Dual-stack approach



Edge-only approach

The edge is legacy access switches



PANOPTICON



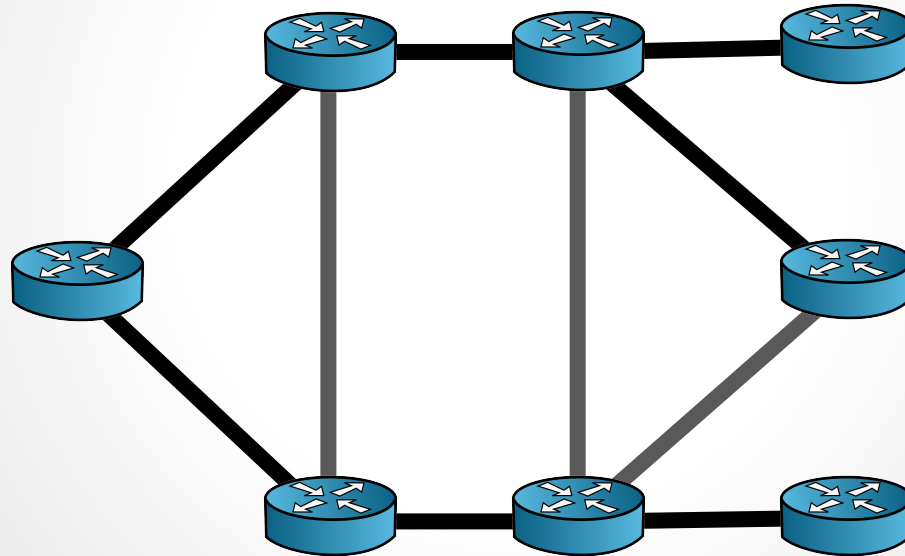
SDN ARCHITECTURE

Operate the network as
a (nearly) full SDN

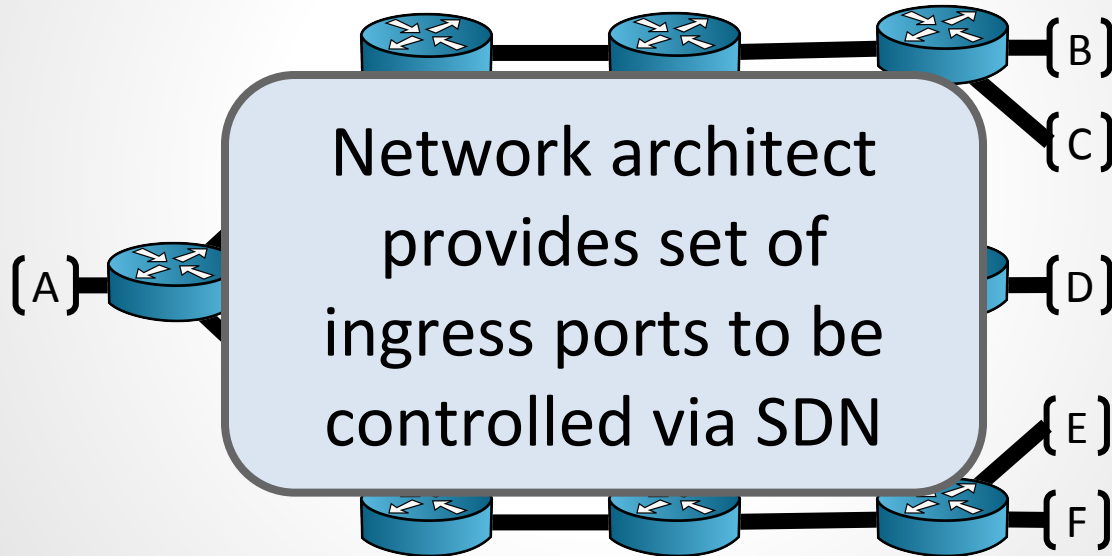
TOOL

Determine the partial
SDN deployment

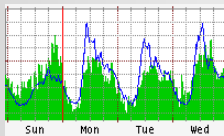
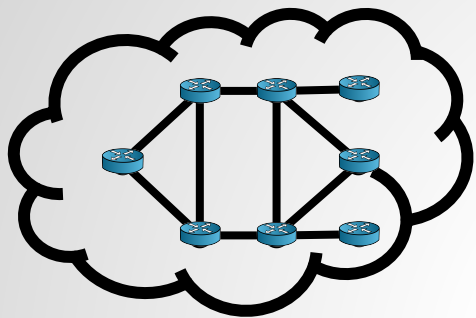
The Existing Network



1. Planning the SDN Deployment



Network topology



Traffic estimates



Objectives

- Upgrade budget
- Path delay

Tunable parameters

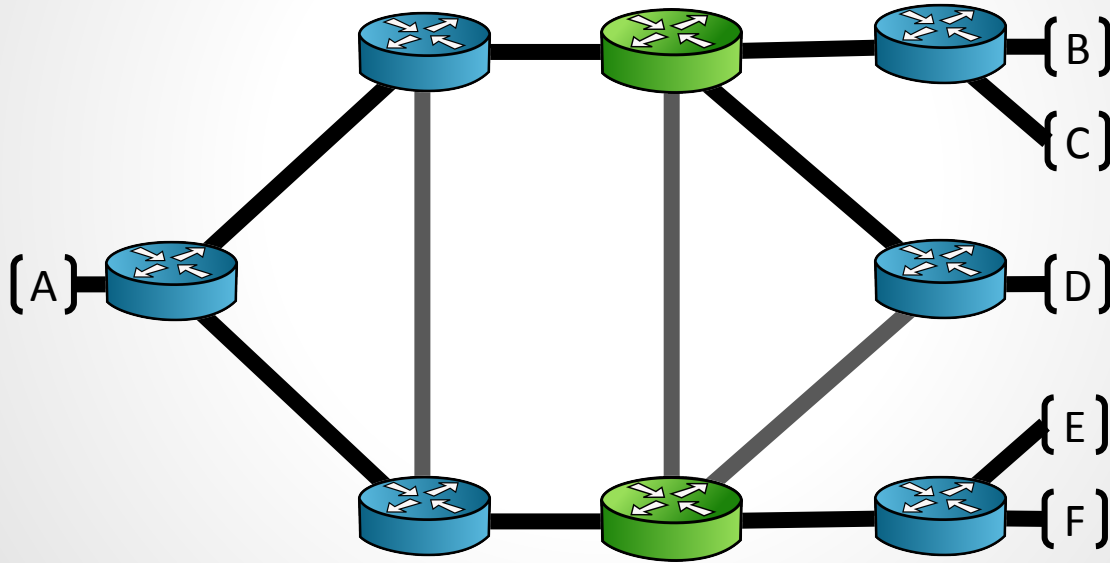
- Port priorities
- Price model
- Utilization thresholds
(link utilization, VLANs, etc.)



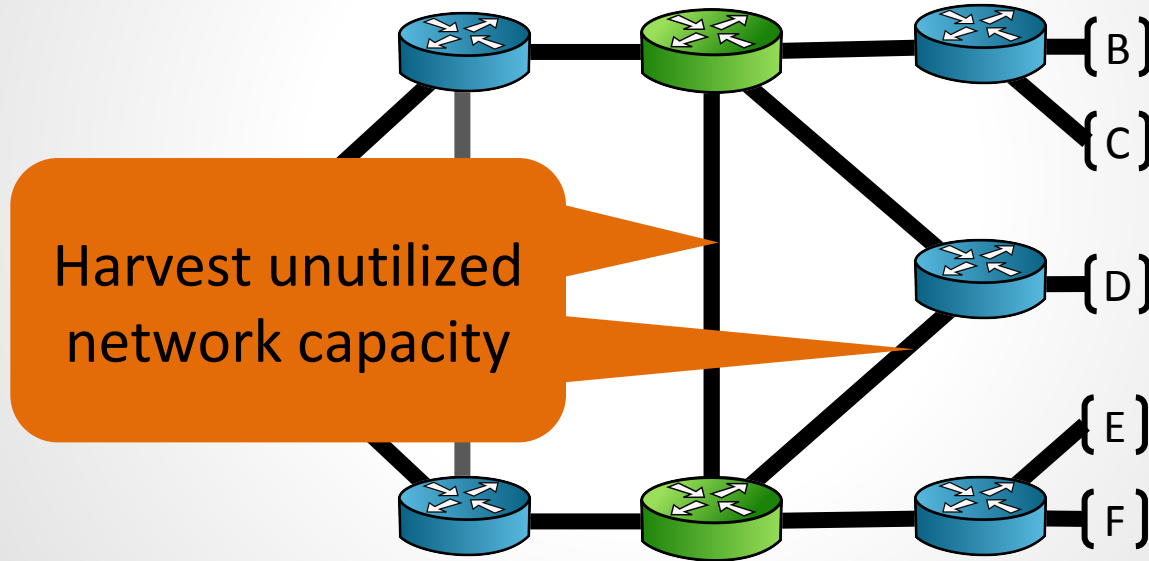
**resource
aware
optimizer**

**Partial SDN
deployment**

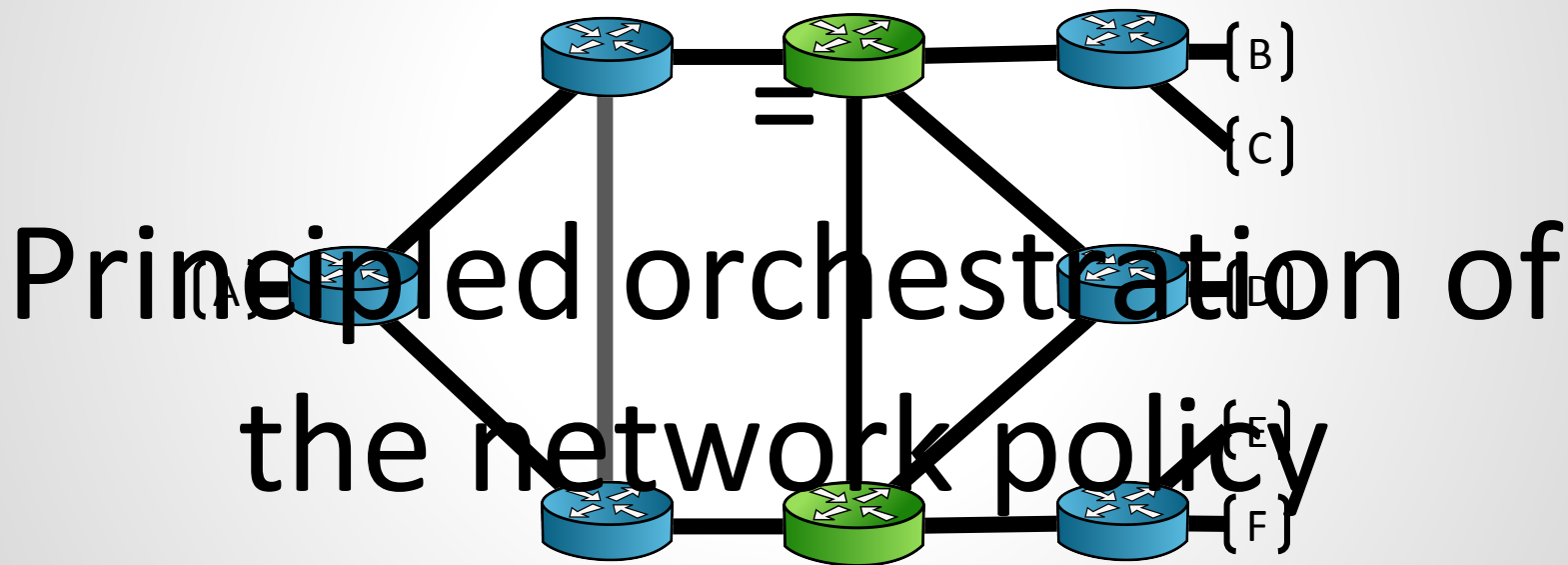
The Partial SDN Deployment ()



Benefits of Partial SDN Deployment?



Main benefits of SDN

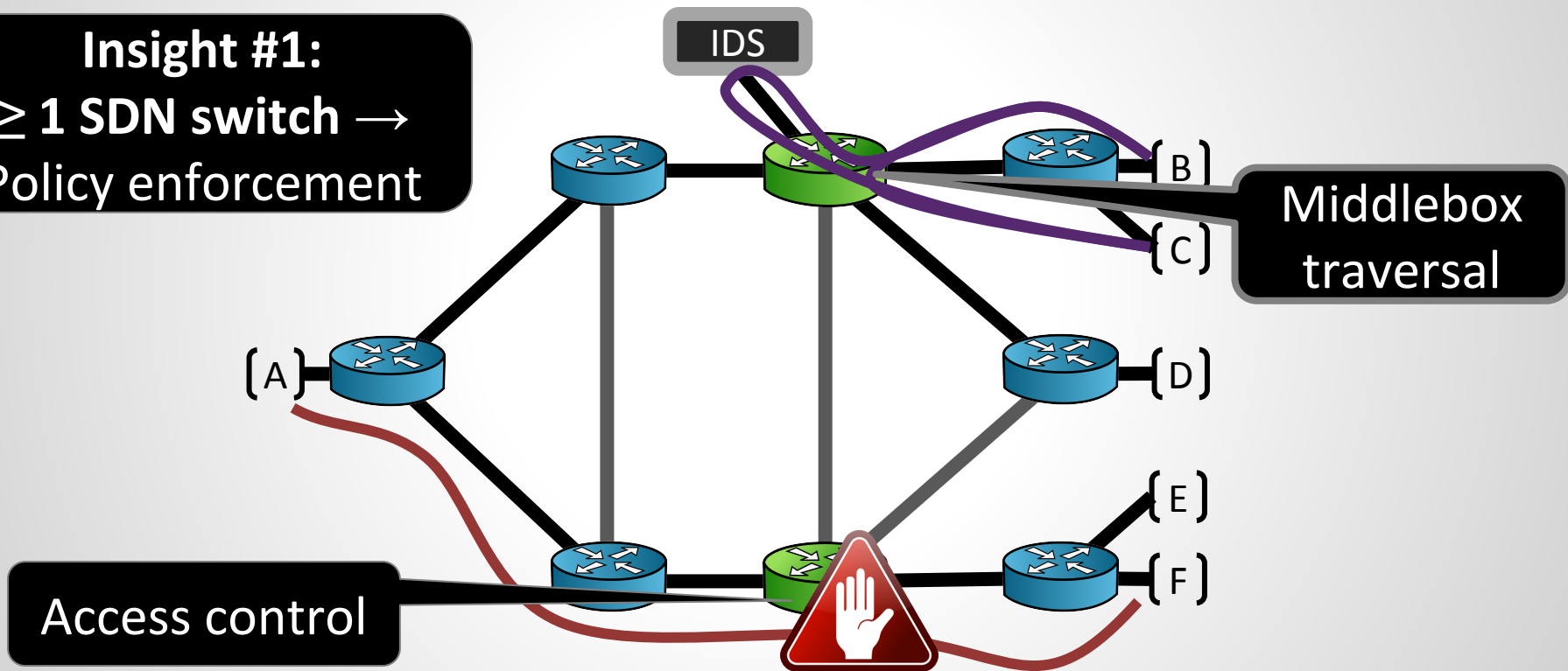


Can partial SDN deployment
still take advantage of
principled network orchestration



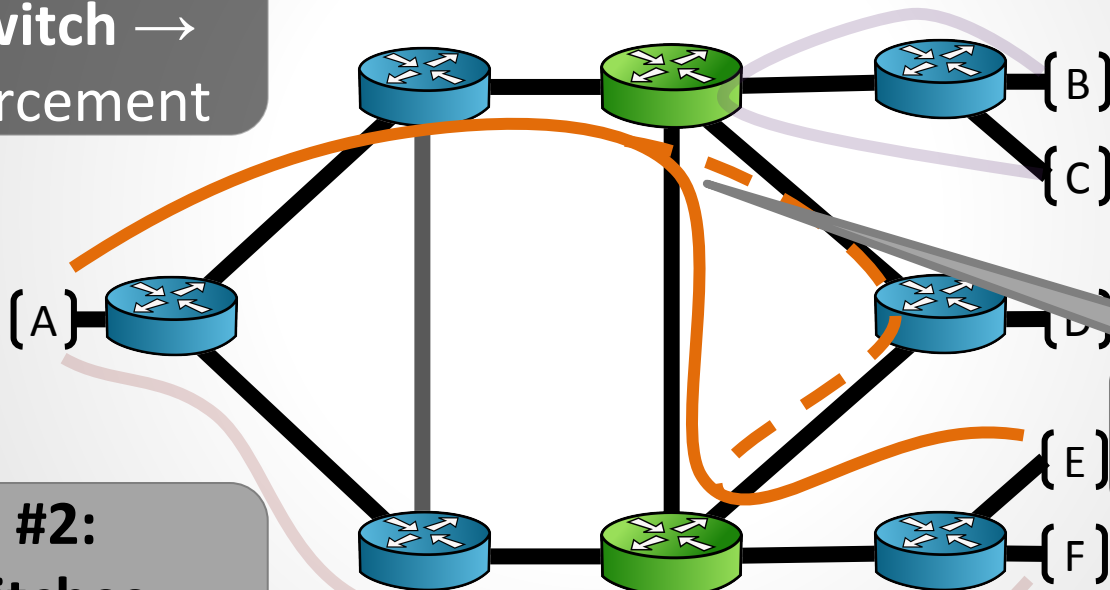
2. Realizing the Benefits of SDN

Insight #1:
 ≥ 1 SDN switch \rightarrow
Policy enforcement



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Insight #2:
 ≥ 2 SDN switches \rightarrow
Fine-grained control

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Policy enforcement

Insight #2:
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Fine-grained control

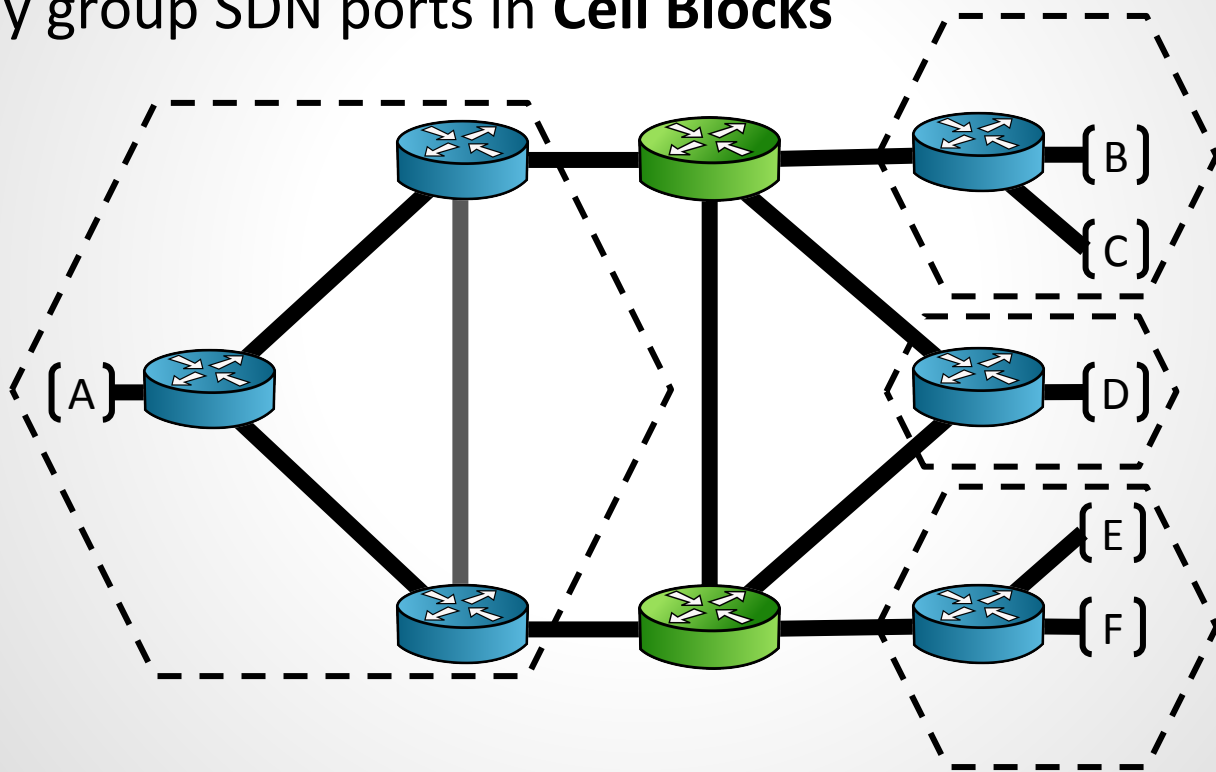
Ensure that all traffic to/from
an SDN-controlled port always
traverses at least one SDN switch

SDN Waypoint Enforcement

Legacy devices must direct traffic to SDN switches

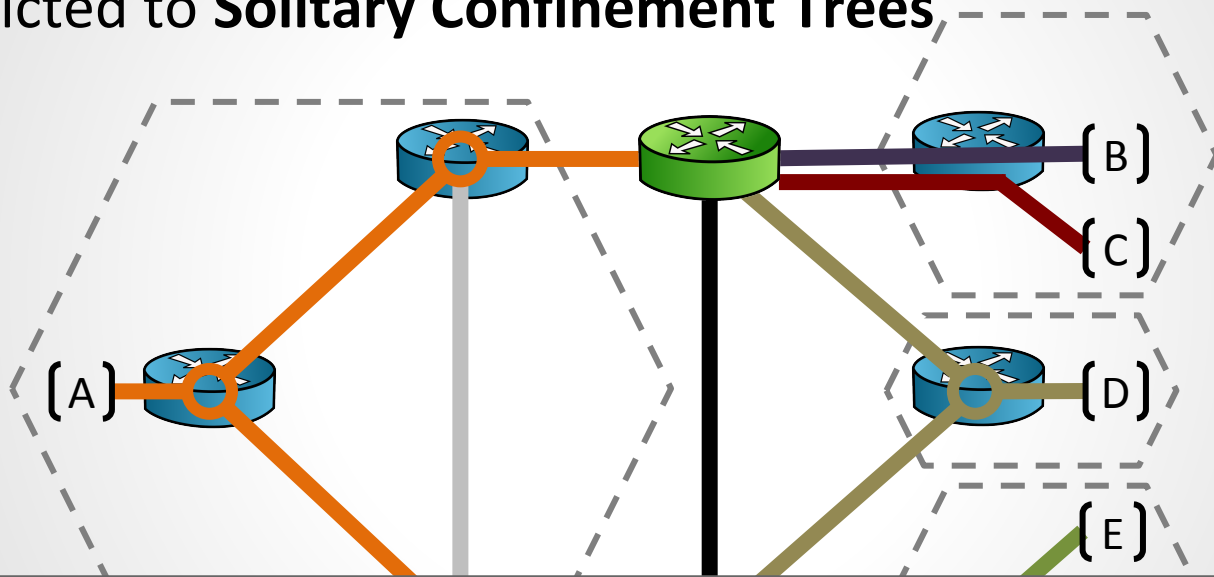
The **PANOPTICON** SDN Architecture

Conceptually group SDN ports in **Cell Blocks**



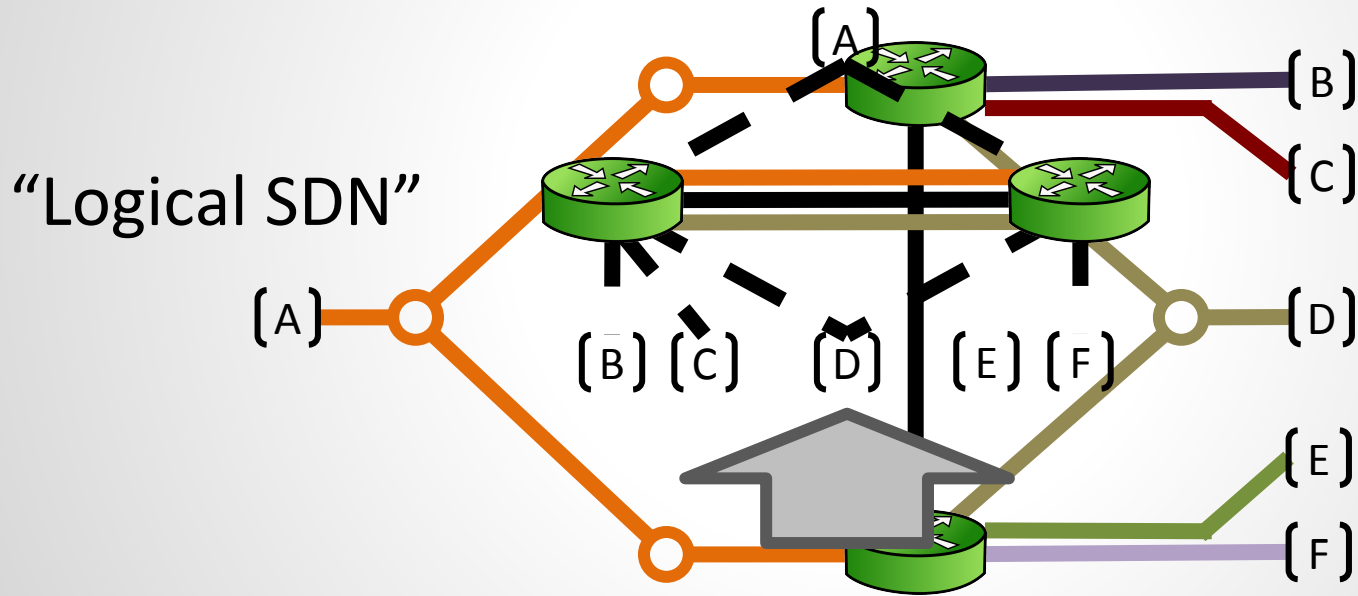
The **PANOPTICON** SDN Architecture

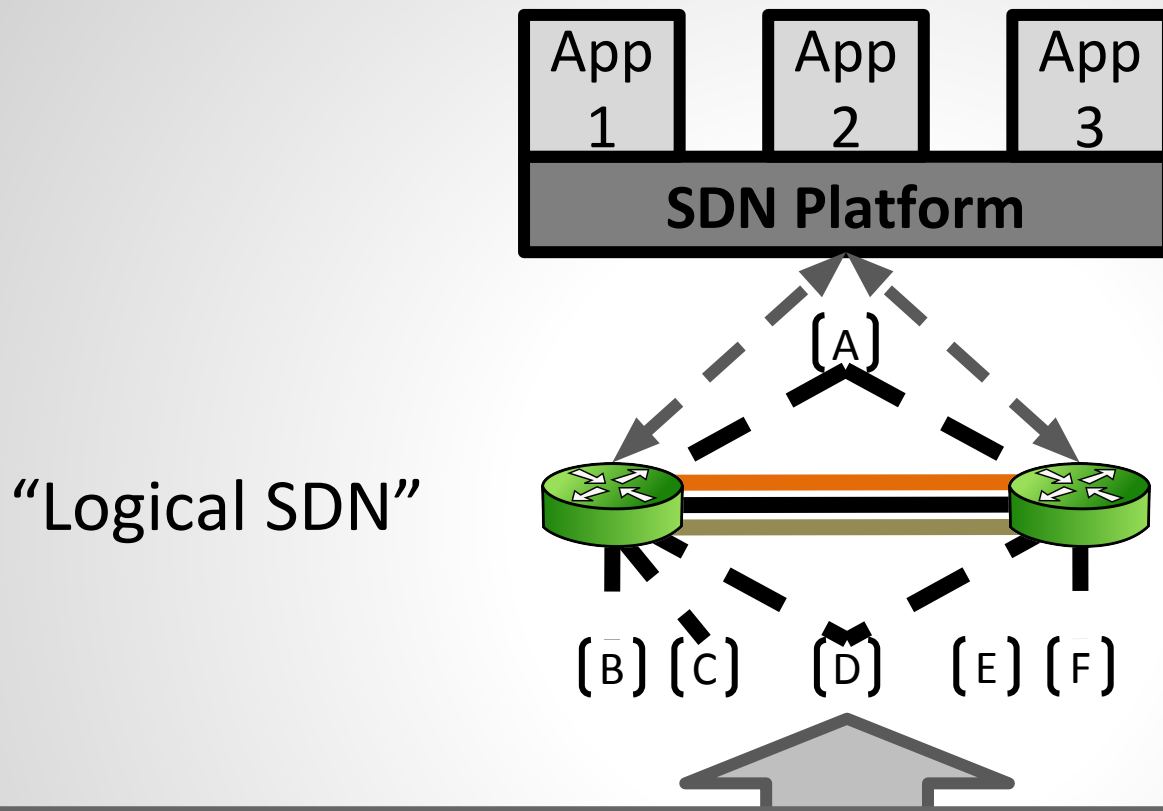
Traffic restricted to **Solitary Confinement Trees**



**Per-port spanning trees that
ensure waypoint enforcement**

PANOPTICON





“Logical SDN”

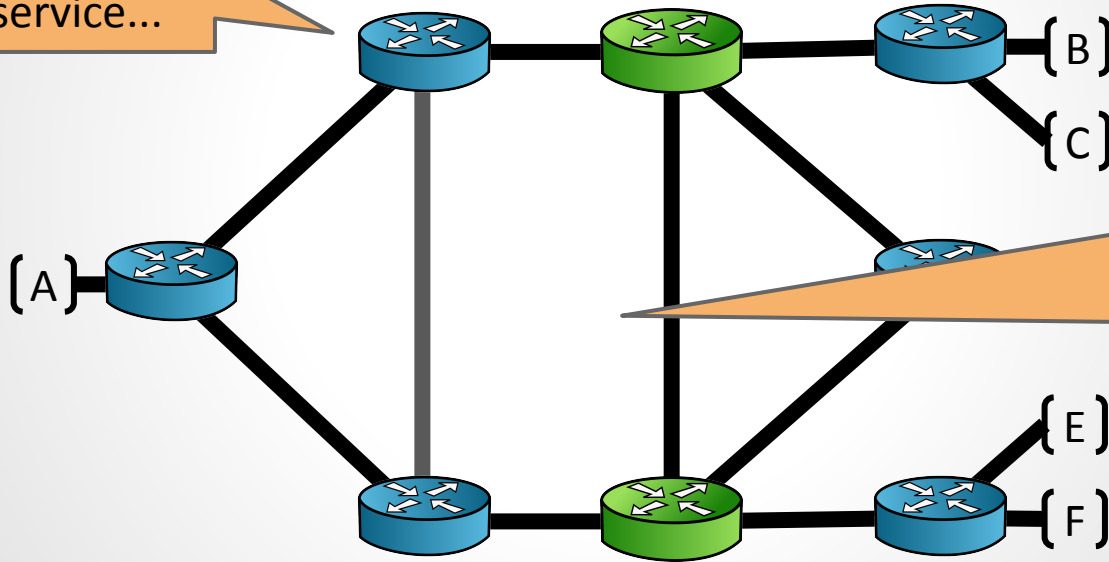
PANOPTICON provides the abstraction of a (nearly) fully-deployed SDN in a partially upgraded network

Hybrid SDN Use Cases

- **Automated Planned Maintenance Tool**
- Lightweight IP Subnet Mobility
- ACL refactorization
- Middle-box Traversal

Use Case: Planned Maintenance

Operator says:
"You're Going
down for service..."



...and, could the
rest of you
switches
cooperate to
minimize the
disruption?

Use Case Testbed Evaluation

2x NEC IP8800 (OF 1.0)

1x Cisco C3550XL

3x Cisco

2x HP 54

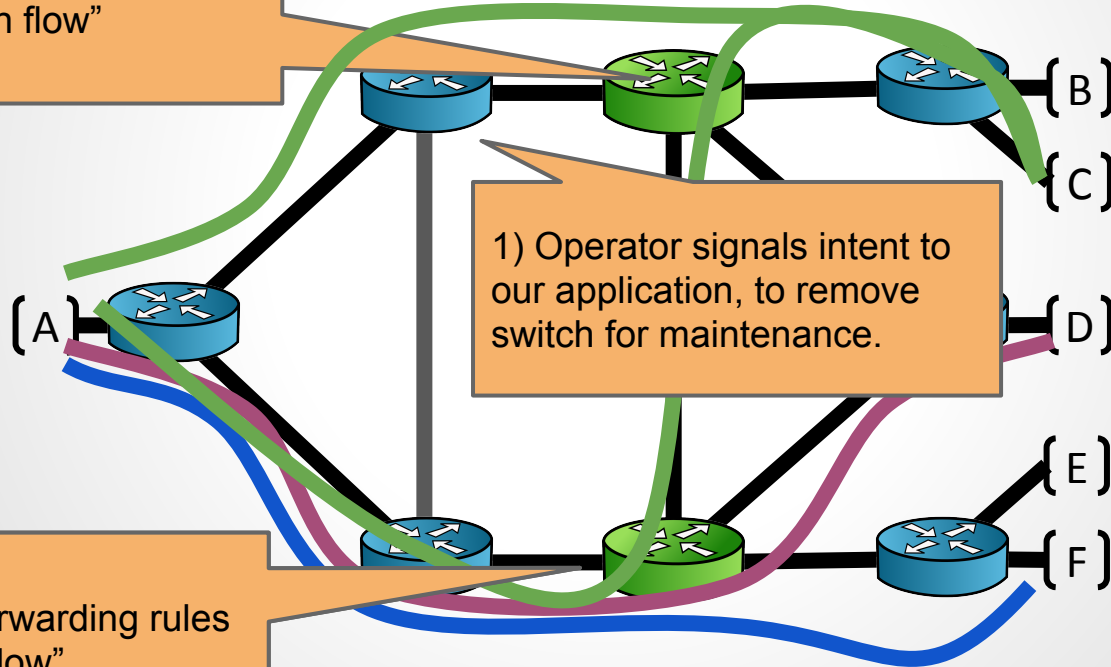
TCP Connection
Recovery Time

Locations of “port-down” events
along one path traversing SDN
switch.



Use Case: Planned Maintenance

3) Update forwarding rules to re-route "green flow"



2) Install forwarding rules for "green flow"

Use Case Testbed Evaluation

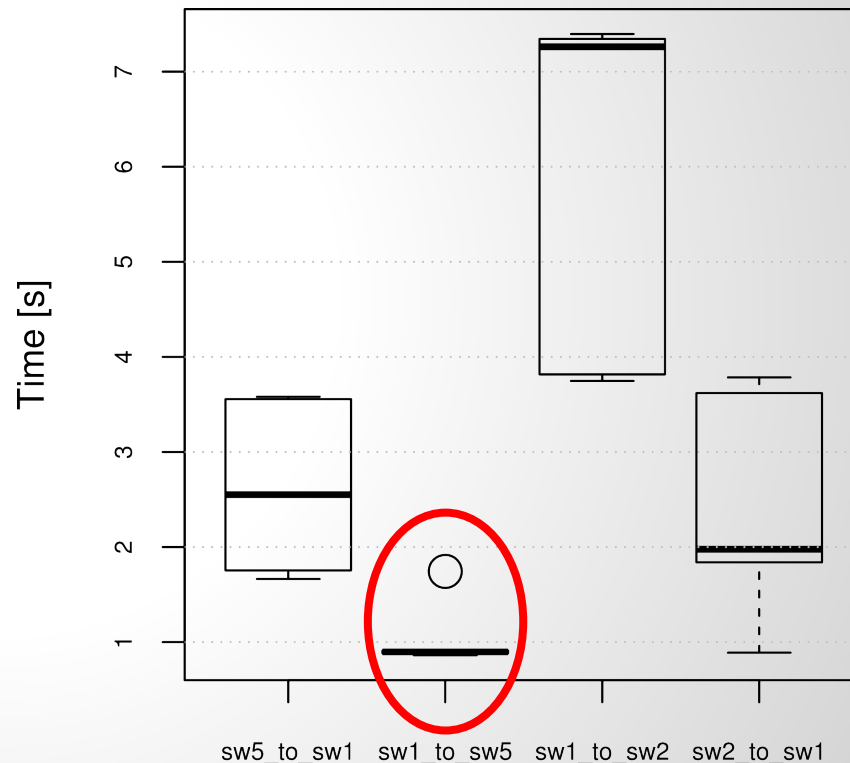
2x NEC IP8800 (OF 1.0)

1x Cisco C3550XL

3x Cisco C2960G

2x HP 5406zl

1x Pica8 3290



Key Results Highlights

- Evaluated a large campus network (1500+ switches)
- Real topologies and real traffic traces
- Upgrade **2%** of the switches/routers →
 - 100% SDN-controlled ingress ports
 - avg. path stretch < 50%
 - 90th percentile link util. < 25% increase

Also, we're Hiring.

<https://venture.badpacket.in>

Contact us!

Summary

SDN ARCHITECTURE

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TOOL

Determine the partial
SDN deployment

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