High-speed Networks, Cybersecurity, and Software-defined Networking Workshop

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Lab 7: Interconnecting Legacy and SDN networks

Potential Drawbacks of SDN

- SDN networks have many advantages over traditional networks
  - Ease of network management
  - Enforcement of security policies
  - Customized network behavior
- However, SDN is typically not fully deployed in networks due to several reasons
  - Limited budget for new network infrastructure
  - Fear of downtime during the transition to SDN
  - Limited training opportunities in SDN technology

R. Amin, M. Reisslein, N. Shah, Hybrid SDN networks: A survey of existing approaches, IEEE CST, Vol. 20, Issue: 4, 2018.

Potential Drawbacks of SDN

- One possible solution to address these concerns is to deploy a limited number of SDN-enabled devices alongside the traditional (legacy) network devices

- Incrementally replacing traditional network devices by SDN devices

- The network can be converted in stages, targeting specific network areas for conversion and rolling out the changes incrementally

    - A network containing a mix of SDN and legacy network devices is referred to as a hybrid SDN network
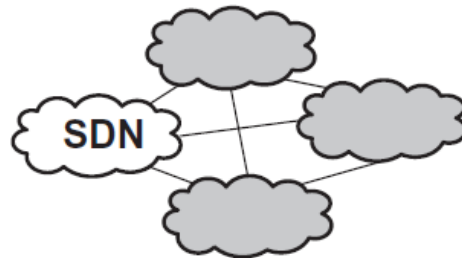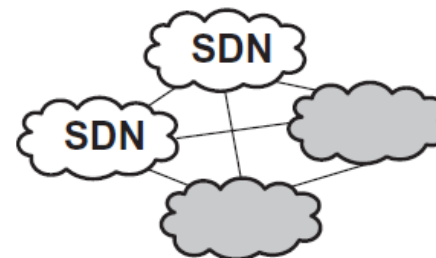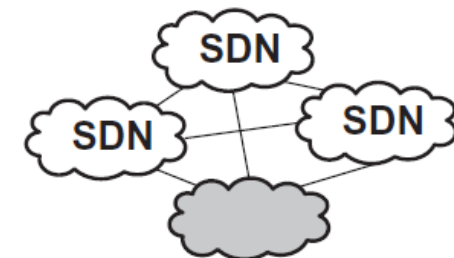
Advantages of Hybrid SDN Networks

- Hybrid SDN networks ease these budget concerns
  - Cost of replacing legacy devices by SDN devices
  - Train engineers to design, configure, and operate the SDN network
- SDN provides fine-grained control for data traffic flows
  - If this is required for a small network portion, then SDN can be implemented in that portion only
- Scenarios where two SDN networks are interconnected by legacy network devices require hybrid SDN network mechanisms
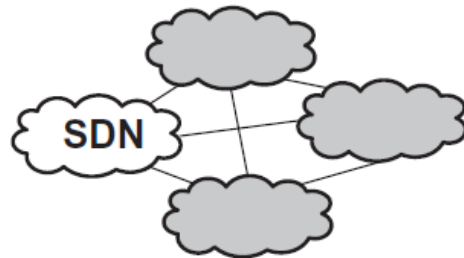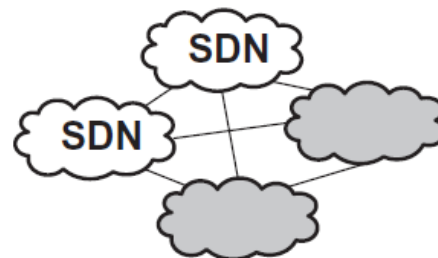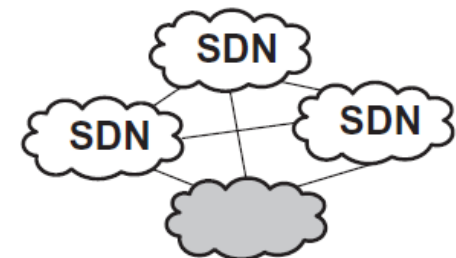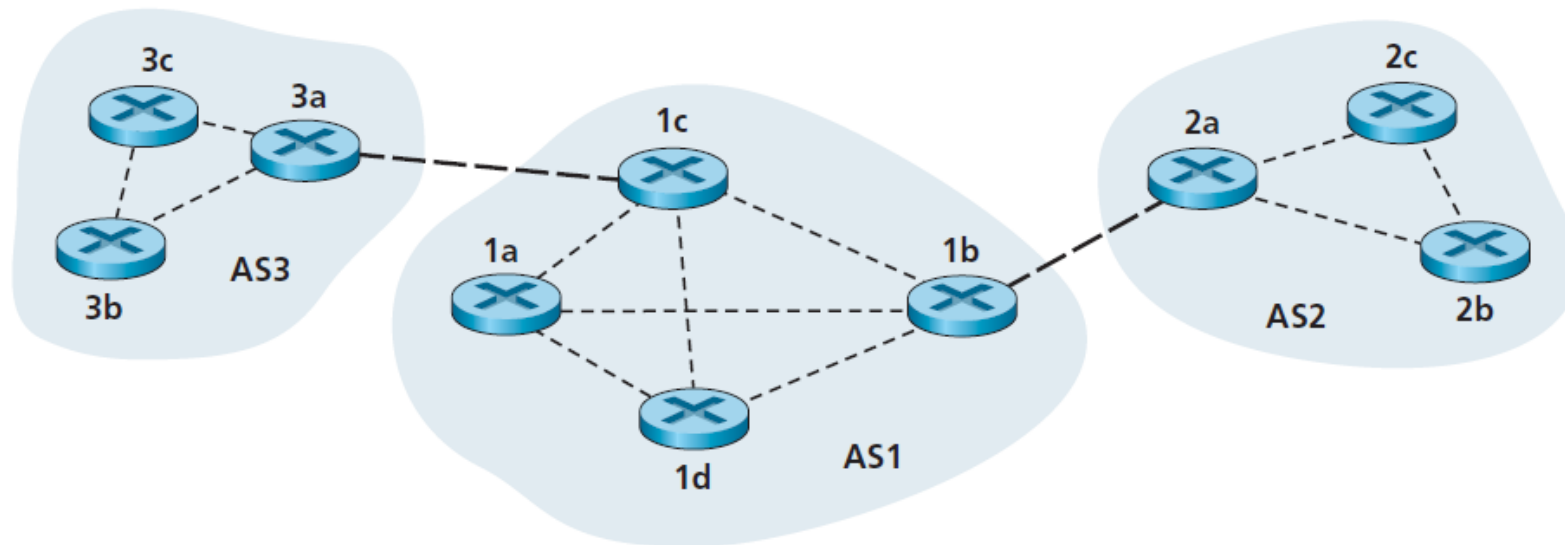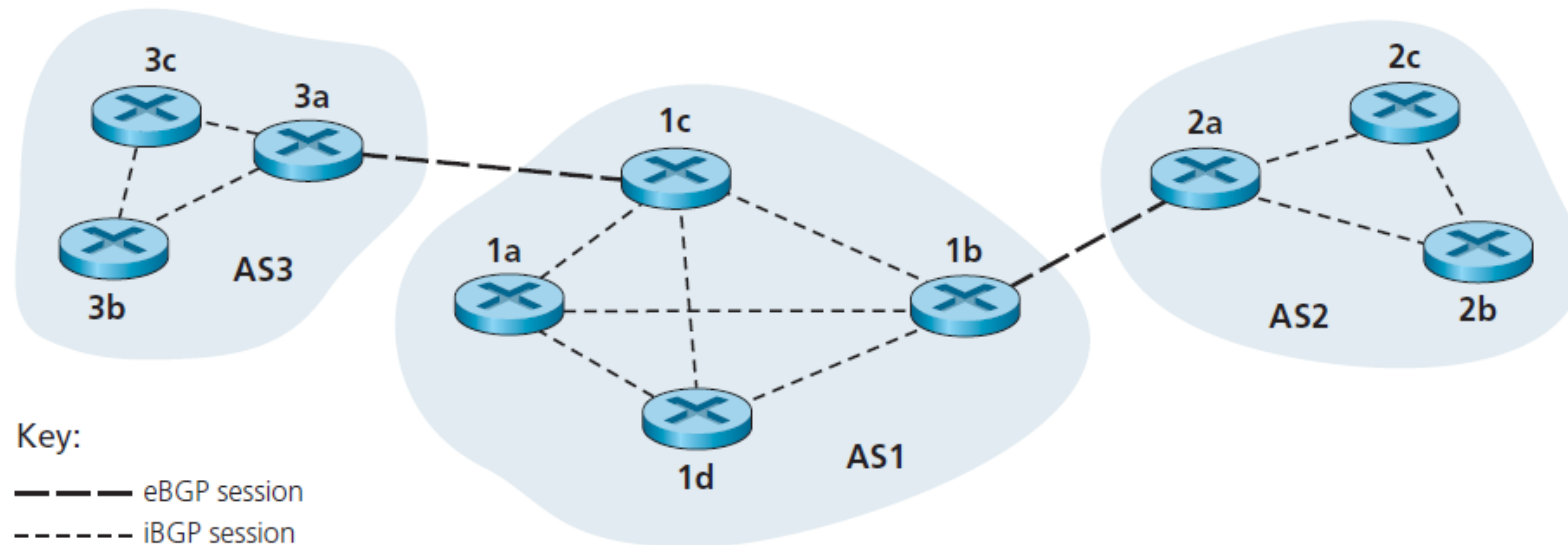
Border Gateway Protocol

- The Border Gateway Protocol (BGP) version 4 is the standard inter-autonomous system (AS) protocol in today's Internet
  - An AS is a group of routers typically under the same administrative control (e.g., ISP, company)
  - BGP is the *"glue that holds the Internet together"*
- In BGP, pairs of routers exchange routing information over TCP (default port 179)

J. Kurose, K. Ross, Computer Networking: A Top-Down Approach, 7th Edition, Pearson/Addison Wesley, 2017.

Border Gateway Protocol

- BGP provides each AS a means to:
  - eBGP: obtain subnet reachability information from neighboring ASes
  - iBGP: propagate reachability information to AS-internal routers
  - Determine "good" routes to other networks based on reachability information and policy
- Allows subnet to advertise its existence to rest of Internet: "I am here"

J. Kurose, K. Ross, Computer Networking: A Top-Down Approach, 7th Edition, Pearson/Addison Wesley, 2017.
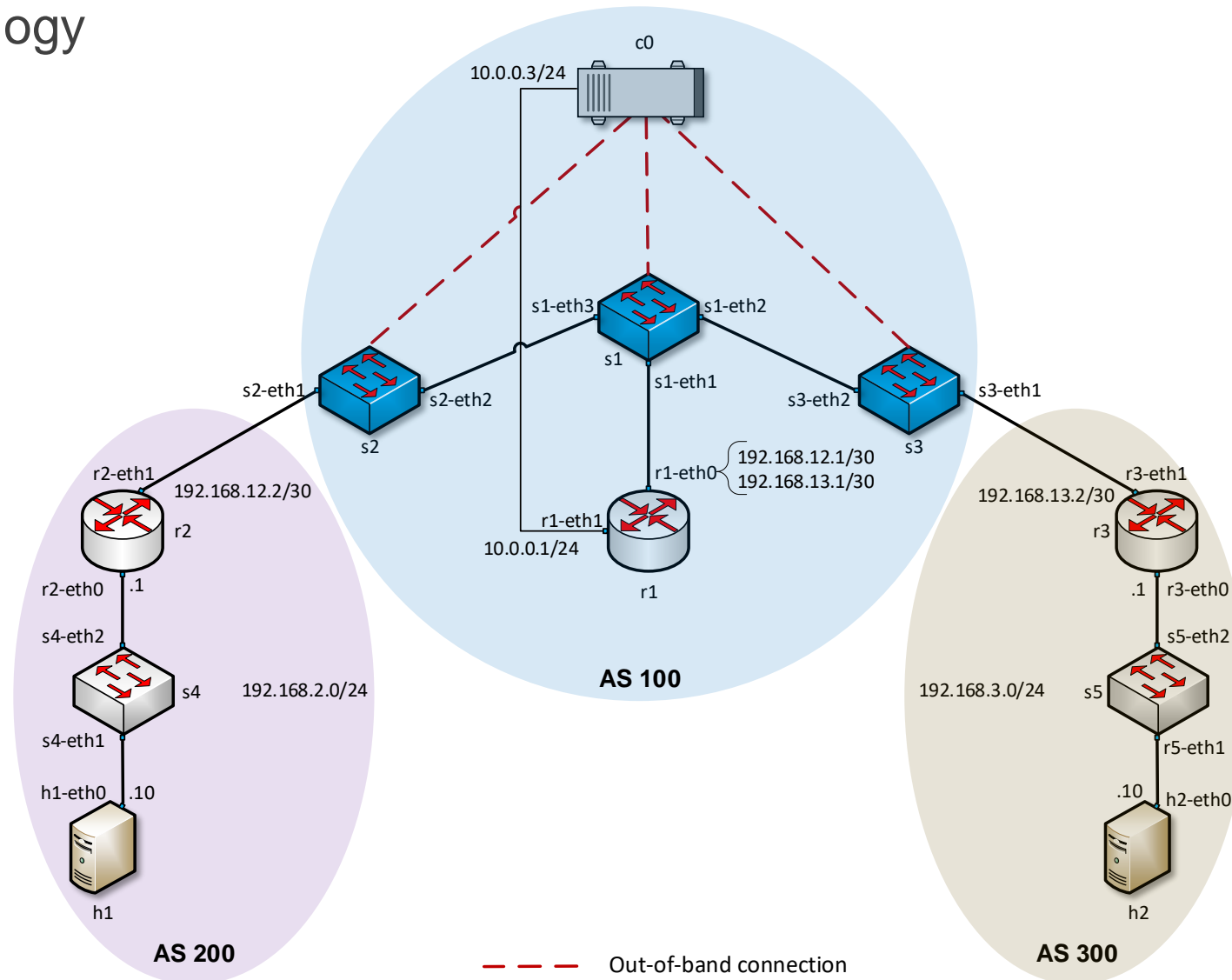
Lab 7: Interconnecting Legacy and SDN networks

- Two legacy networks connected to an SDN network
- SDN network consists of switches controlled by an ONOS controller
- The ONOS controller interacts with an application referred to as SDN-IP
- SDN-IP allows the SDN network to i) exchange BGP information with an iBGP router; and ii) translates routing information to SDN flow rules
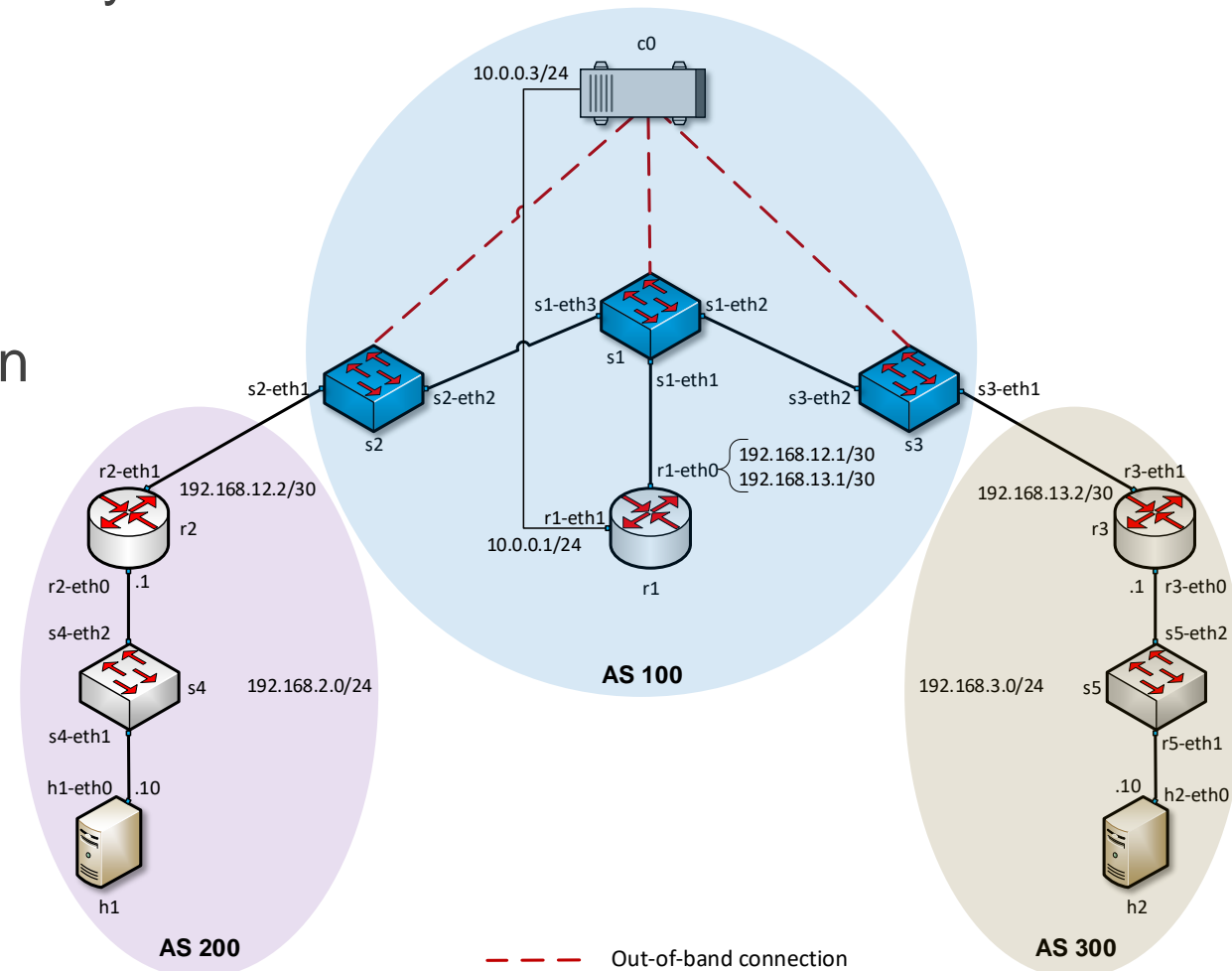
Lab 7: Interconnecting Legacy and SDN networks

- Network Topology

Lab 7: Interconnecting Legacy and SDN networks

- Simplified communication pattern
  1. r2 and r3 attempt to connect to r1 (eBGP)
  2. s2 and s3 forward incoming packets to controller
  3. Controller installs rules to forward those BGP packets to r1
  4. r1 exchanges BGP information to controller (iBGP)
  5. Controller translates BGP information into rules
  6. Rules are installed in s1, s2, and s3 (remote networks)
  7. Full connectivity is established