Underlay Network Automation

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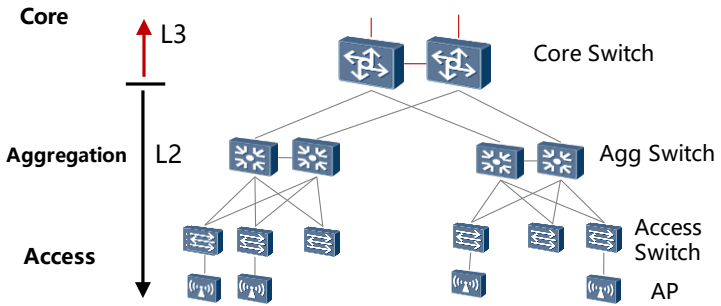
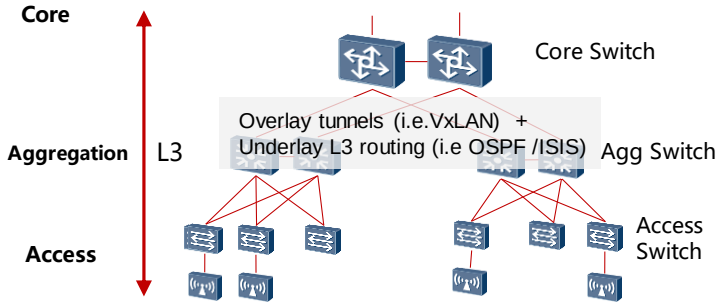
Presentation objectives

- Outline requirements of underlay network automation.
- Discuss current gaps.
- Propose solutions to address the requirements.

Deploying an overlay is an emerging technology for campus LAN

The main functions of Campus LAN: provide connectivity & policy control (i.e segmentation, who can access what).

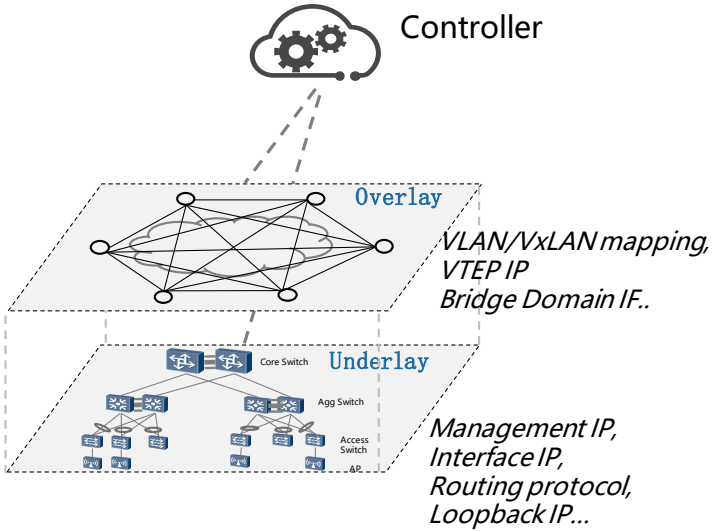




- Traditional network
  - Policy is correlated with port location, VLAN and/or ACLs.
  - Policy is enforced by different devices at different layers .
  - Complex for policy provisioning, track and adapt when network change (i.e mobility, BYoD.).
  - Typically L2 using STP. Challenges with large-scale and maximizing utilization via load balancing.

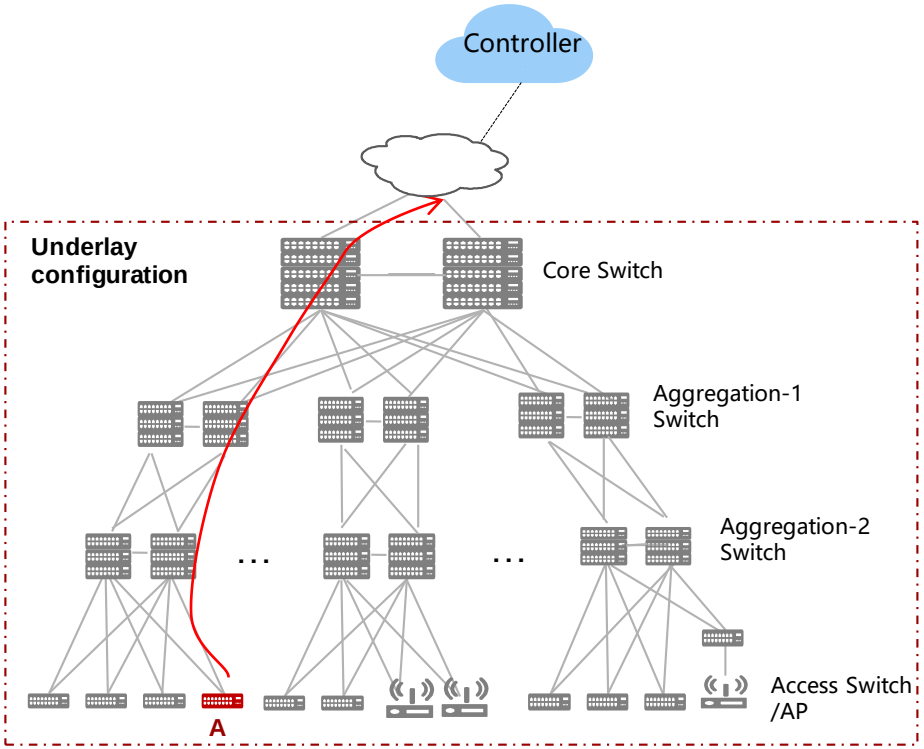
- Overlay network
  - Create L2 virtual tunnels (overlay) over L3 network. Policy is only provisioned on edge devices and transparent for inter-medium nodes. Easy for policy automation (i.e with SDN).
  - Underlay provides simple and high available connectivity, with the benefits of L3 network, i.e. fast convergence, ECMP, scalability.
  - Already supported by many vendors.

Underlay network automation: improve LAN deployment efficiency



- The network configurations can be divided into two parts:
  - Overlay network: used to provide policy provisioning such as VLAN/VxLAN mapping, VxLAN tunnel establishment…
  - Underlay network: used to provide connectivity and availability, i.e. device management IP, interface IP, routing protocol parameters, loopback IP ….
- The overlay network is typically configured via SDN controller at NOC after on-site devices can be managed remotely. Some initial underlay configurations for each device are required to get a L3 network up and running.
- Configuring the underlay network for a large-size LAN could be very time-consuming even for skilled network engineer. i.e configuring loopback IP, interface interconnecting IP and specifying the routing protocol and its parameters for thousands of switches and APs.
- Configuration automation would significantly lower the configuration overhead and reduce the cost for network deployment.
  - Eliminate repetitive configuration tasks and minimize on-site workload
  - Less skilled technician required on-site
  - Avoid human error

Automating underlay network configuration



- Power-on device defaults settings are L2. To get an L3 network up and running, the following is needed:
  - Devices need to obtain an IP address.
  - Devices need specific L3 configuration
    - Specific routed interface IP address
    - Loopback IP address
    - Routing protocol configuration (e.g. OSPF, ISIS)
  - Prevent L2 loops during L3 initialization.
- A special “entity” in the network is required. Its function include:
  - Discover the complete LAN topology;
  - Enable communication for management and configuration;
  - Enable automatic configuration for L3 routing parameters (convert the L2 device to an L3 device).

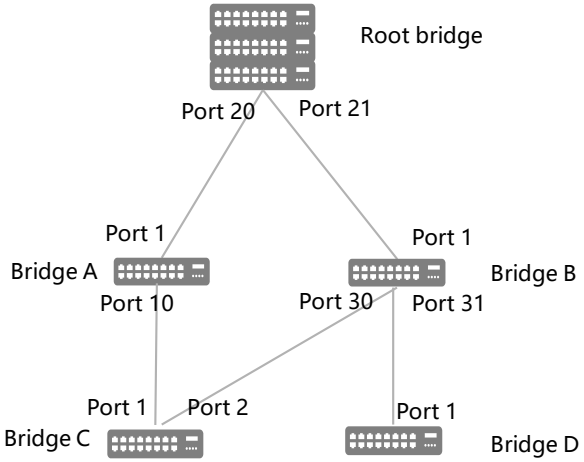
Current 802.1 LLDP protocol capability

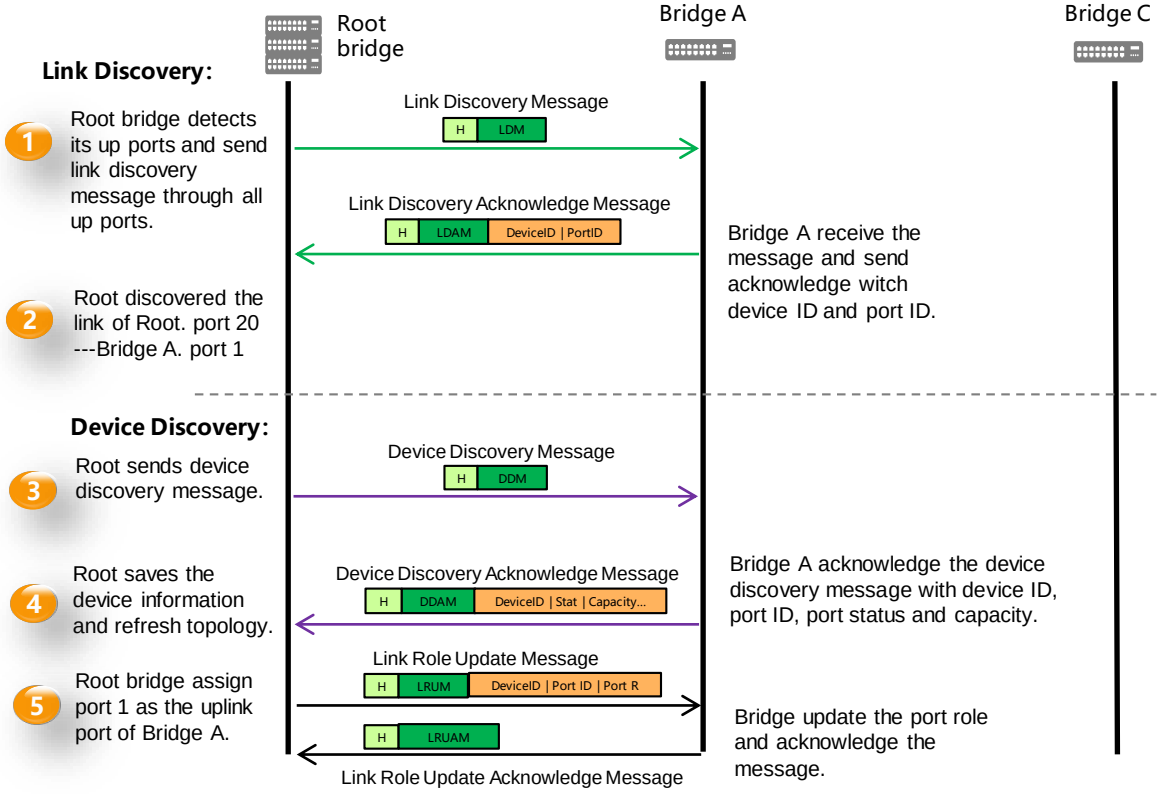
- **802.1AB LLDP mechanism**
  - Advertises connectivity and management information about the local station to adjacent stations on the same IEEE 802 LAN.
  - Receives network management information from adjacent stations on the same IEEE 802 LAN.

- **802.1AB LLDP capability**
  - Discovers its neighbor node, relies on 3rd party (such as controller) to discover the complete topology.
  - Doesn't enable communication for configuring L3 routing parameters on other devices.

Proposed solution: a new protocol for underlay network automation

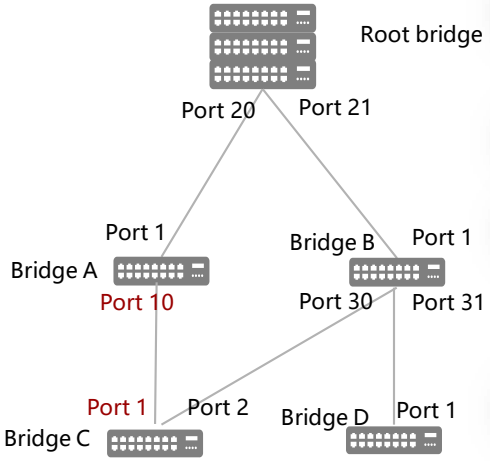
- Global topology discovery— “root-direct-connecting” bridge discovery





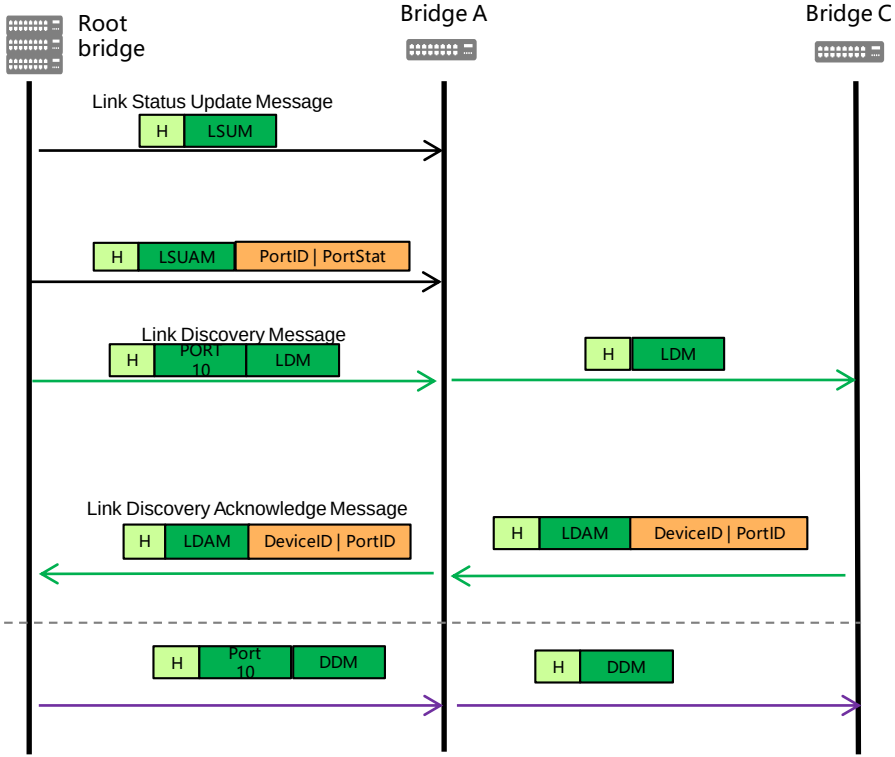
Proposed solution: a new protocol for underlay network automation

- Global topology discovery –further bridge discovery



Link Discovery:

1. When Bridge C connects to Bridge A, Bridge A detects the port 10 is up and send link status update message to Root bridge to indicate the change.
2. Root Ack the message and find that it is a new port unassociated with any link in its database.
3. Root send link discovery message encapsulated with port tag ID 10 via its port 20 . the Bridge A will then forward the message via its port 10 as indicated port tag (see next slide). Bridge A will also strip the port tag of the message before it forward to Bridge C.
3. Bridge C Ack the link discovery message via its uplink port. Bridge A will also forward it via its uplink port.

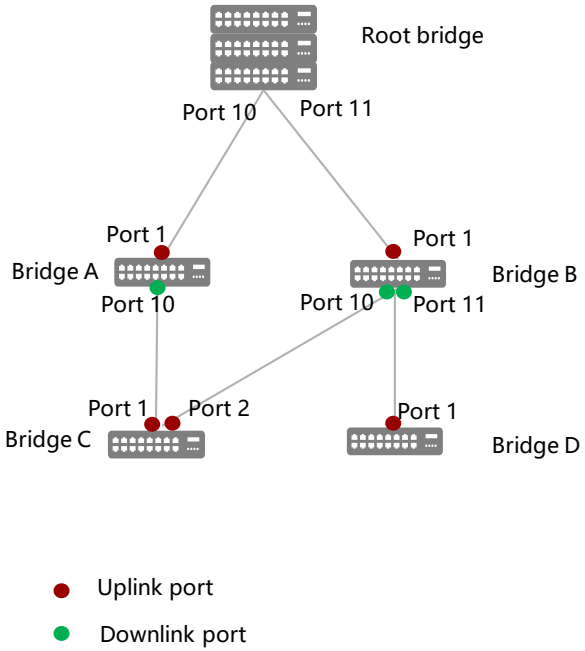


Device Discovery:

The device discovery is similar as previous slide. Only all the messages need to traverse though Bridge A.

Proposed solution: a new protocol for underlay network automation

- L2 communication path establishment and L3 parameter configuration



- The Root bridge will build a shortest path tree for whole network by assigned the uplink port(s) for all other bridge.

From South to North

- Each port of non-root bridge either is an uplink port or downlink port.
- The frame received by a downlink port will be forwarded to uplink.
- The frame received by a downlink port is not allowed to forward to another downlink.

From North to South

- Root bridge will encapsulate the port tag in the frame to indicate the egress port of each hop.
- Each bridge will exam the tag and decide how to forward
  - If there is a port tag, forward to the corresponding port;
  - If no part tag, send to Higher Layer Entities to process.

- Root bridge can assign the IP address and provide configuration for L3 routing protocol for all other non-root bridges.

Summary

- The presentation outlines the requirements of underlay network automation.
  - Discover the complete LAN topology;
  - Enable communication for management and configuration;
  - Enable automatic configuration for L3 routing parameters (convert the L2 device to an L3 device)
- It proposes a new solution to automate underlay network configuration without human intervention for the large number non-root bridges.
  - Self-organized
  - Plug and play
- Next Step
  - More discussion ?
  - Potential to form a new PAR?

Thank you