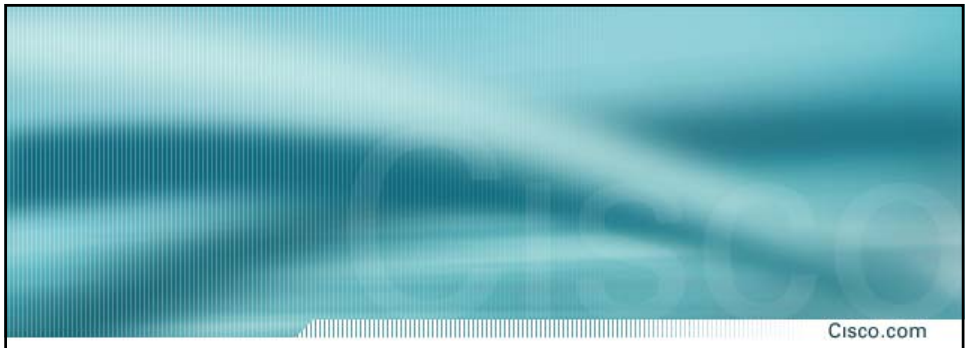

Multilayer Switching (CCNP3 v 5)

Halmstad University

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Module 8: Minimizing service loss and data theft in a campus network

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- Port security
- PVLANs and VACLs
- VLAN hopping
- DHCP spoofing
- ARP spoofing
- STP attacks
- Vty ACLs
- SSH

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Unauthorized Access by Rogue Devices

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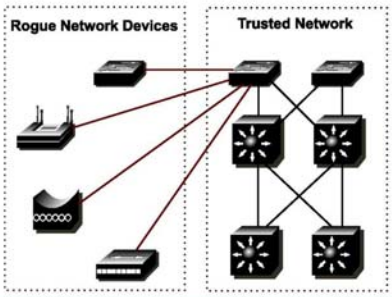
Rogue Access Points

FIGURE 1



- Rogue network devices can be:
  - Wireless hubs
  - Wireless routers
  - Access switches
  - Hubs
- These devices are typically connected at access level switches.

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Switch Attack Categories

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- **MAC layer attacks**
- **VLAN attacks**
- **Spoof attacks**
- **Switch device attacks**

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MAC Flooding Attack

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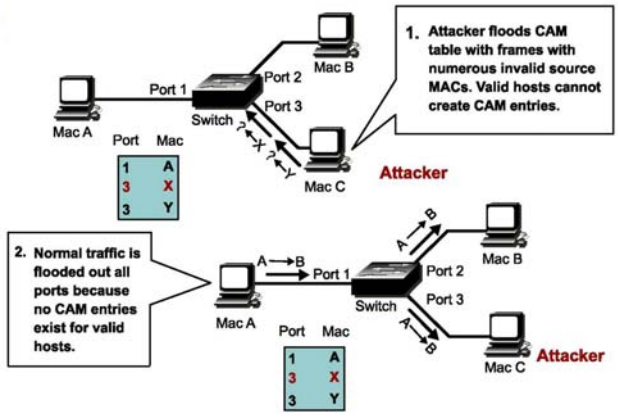
MAC Flood Attack

FIGURES

1
2



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MAC Flood Attack Progression

FIGURES

1
2

Step	Description
1	Switch forwards traffic based on valid CAM table entries.
2	Attacker (MAC address C) sends out multiple packets with various source MAC addresses.
3	Over a short period of time, the CAM table in the switch fills up until it cannot accept new entries. As long as the attack is running, the CAM table on the switch will remain full.
4	Switch begins to flood all packets that it receives out of every port so that frames sent from host A to host B are also flooded out of port 3 on the switch.

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To mitigate against MAC flooding, port security is configured to define the number of MAC addresses that are allowed on a given port.

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Port Security

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Port Security

FIGURES

1

2

Port security restricts port access by MAC address.

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Port Security with Sticky MAC Addresses

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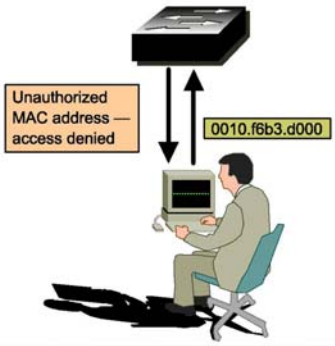
Port Security with Sticky MAC Addresses

FIGURE

1



Sticky MAC stores dynamically learned MAC addresses.

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VLAN Hopping

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Explaining VLAN Hopping

FIGURES

1
2
3
4

- Attacking system spoofs itself as a legitimate trunk negotiating device.
- Trunk link is negotiated dynamically.
- Attacking device gains access to data on all VLANs carried by the negotiated trunk.

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VLAN Hopping

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Switch Spoofing Sequence of Events

FIGURES

1
2
3
4

Step	Description
1.	Attacker gains access to a switch port and sends DTP negotiation frames toward a switch with DTP running and auto negotiation turned on (often, the default settings).
2.	Attacker and switch negotiate trunking over the port.
3.	Switch allows all VLANs (default) to traverse the trunk link.
4.	Attacker sends data to, or collects it from, all VLANs carried on that trunk.

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VLAN Hopping

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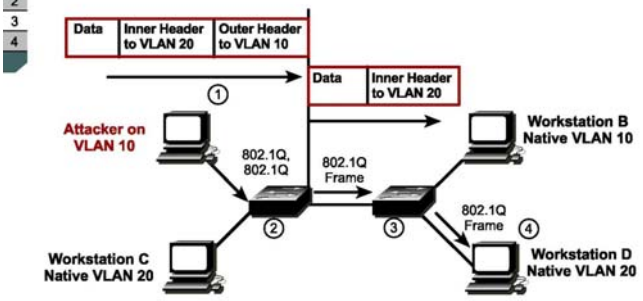
VLAN Hopping with Double Tagging

FIGURES 1 2 3 4



Double tagging allows a frame to be forwarded to a destination VLAN other than the source's VLAN.

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VLAN Hopping

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Double Tagging Method of VLAN Hopping

FIGURES 1 2 3 4

Step	Description
1.	Workstation A (native VLAN 10) sends a frame with two 802.1Q headers to switch 1.
2.	Switch 1 strips the outer tag and forwards the frame to all ports within the same native VLAN.
3.	Switch 2 interprets the frame according to information in the inner tag marked with VLAN ID 20.
4.	Switch 2 forwards the frame out all ports associated with VLAN 20, including trunk ports.

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Mitigating VLAN Hopping

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- **Configure all unused ports as access ports so that trunking cannot be negotiated across those links.**
- **Place all unused ports in the shutdown state and associate with a VLAN designated only for unused ports, carrying no user data traffic.**
- **When establishing a trunk link, configure the following:**
  - **Make the native VLAN different from any data VLANs**
  - **Set trunking as "on," rather than negotiated**
  - **Specify the VLAN range to be carried on the trunk**

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ACL

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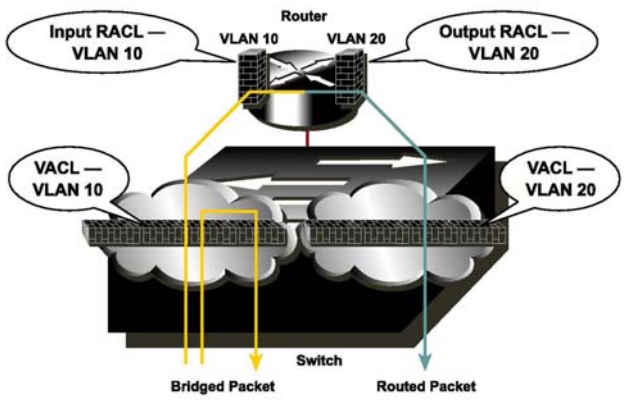
Types of ACLs

FIGURE 1



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Private VLANs and Protected Ports

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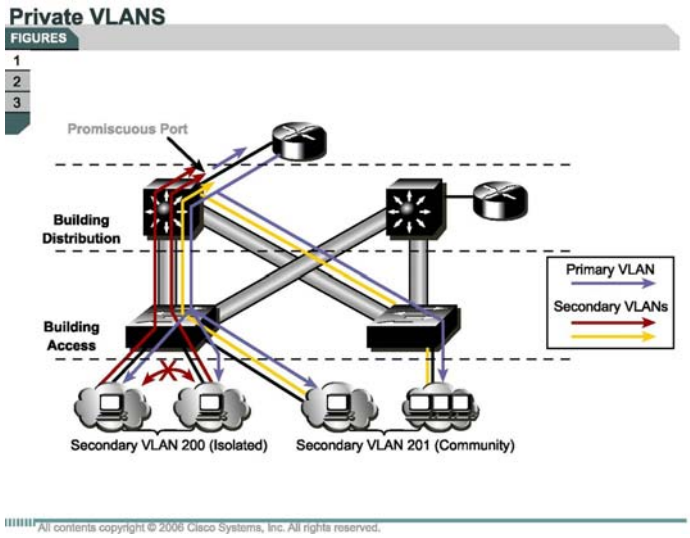

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Private VLANs

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- **Isolated: Has complete Layer 2 separation from other ports within the same PVLAN, except for the promiscuous port. PVLANs block all traffic to isolated ports, except the traffic from promiscuous ports. Traffic received from an isolated port is forwarded only to promiscuous ports.**
- **Promiscuous: Communicates with all ports within the PVLAN, including the community and isolated ports. The default gateway for the segment would likely be hosted on a promiscuous port, given that all devices in the PVLAN need to communicate with that port.**
- **Community: Communicate among themselves and with their promiscuous ports. These interfaces are isolated at Layer 2 from all other interfaces in other communities, or in isolated ports within their PVLAN.**

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16

DHCP Spoof Attack

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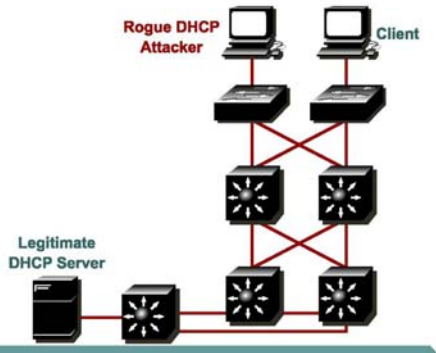
DHCP Spoof Attacks

FIGURES

1

2



- Attacker activates DHCP server on VLAN.
- Attacker replies to valid client DHCP requests.
- Attacker assigns IP configuration information that establishes rogue device as client default gateway.
- Attacker establishes "man-in-the-middle" attack.

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DHCP Snooping

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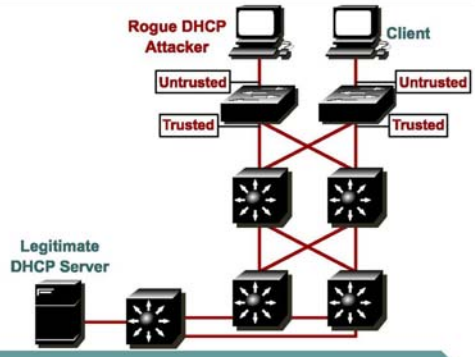
Securing against DHCP Spoofing Attacks

FIGURES

1

2



- DHCP snooping allows the configuration of ports as trusted or untrusted.
- Untrusted ports cannot process DHCP replies.
- Configure DHCP snooping on uplinks to a DHCP server.
- Do not configure DHCP snooping on client ports.

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18

ARP Spoofing

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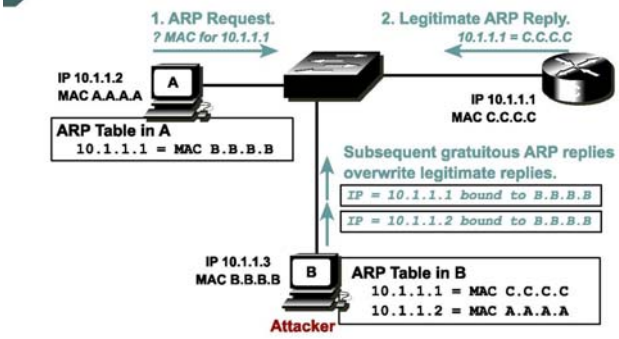
ARP Spoofing

FIGURES

1
2



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19

Dynamic ARP Inspection

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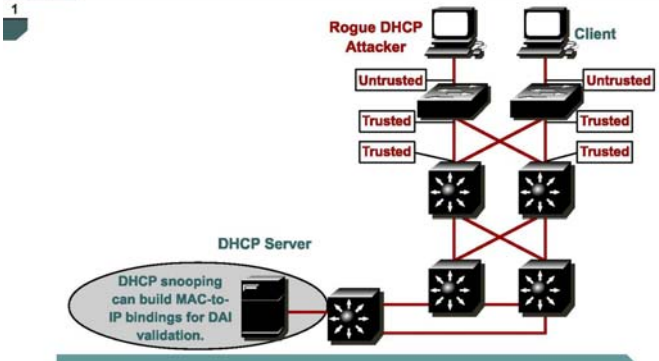
Dynamic ARP Inspection

FIGURE

1



- DAI associates each interface with a trusted state or an untrusted state.
- Trusted interfaces bypass all dynamic ARP inspection.
- Untrusted interfaces undergo DAI validation.

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Protecting Against ARP Spoofing Attacks

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To mitigate the chances of ARP spoofing:

- **Step 1**

Implement protection against DHCP spoofing.

- **Step 2**

Enable dynamic ARP inspection.

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Protecting the Operation of STP

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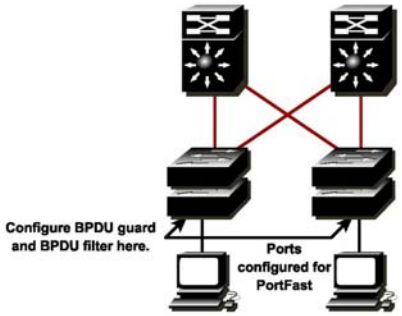
Protecting the Operation of STP

FIGURE 1



Protection against switches being added on PortFast ports.
- BPDU guard shuts ports down.
- BPDU filter specifies action to be taken when BPDUs are received.

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Protecting the Operation of STP

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- BPDU Guard
- BPDU Filtering
- Root Guard
- Unidirectional Link Detection

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Vulnerabilities in CDP

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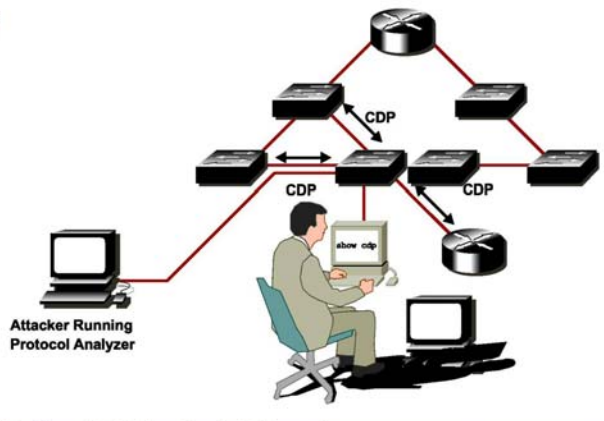
Describing Vulnerabilities in CDP

FIGURES

1

2



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vty ACLs

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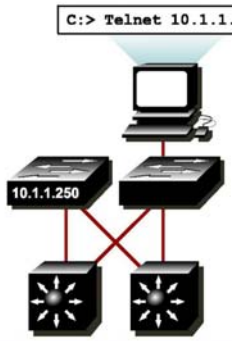
Describing vty ACLs

FIGURE 1



- Set up standard IP ACL.
- Use line configuration mode to filter access with the `access-class` command.
- Set identical restrictions on every vty line.

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25

AAA

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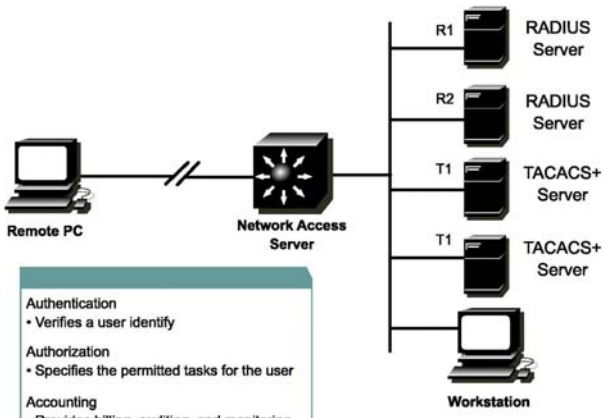
AAA Network Configuration

FIGURE 1



Authentication
- Verifies a user identify

Authorization
- Specifies the permitted tasks for the user

Accounting
- Provides billing, auditing, and monitoring

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26

Best Practices for Switch Security

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The following steps are required whenever placing new equipment in service:

- **Step 1 Consider or establish organizational security policies.**
- **Step 2 Secure switch devices.**
- **Step 3 Secure switch protocols.**
- **Step 4 Mitigate compromises launched through a switch.**

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Best practices for secure switch access

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- **Set system passwords**
- **Secure access to the console**
- **Secure access to vty lines**
- **Use SSH**
- **Configure system-warning banners**
- **Disable unneeded services**
- **Disable the integrated HTTP daemon if not in use**
- **Configure basic logging**

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Best practices to mitigate compromises through a switch

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- Use CDP only as needed
- Secure the spanning tree topology
- Proactively configure unused router and switch ports
- Disable automatic trunk negotiation
- Monitor physical device access
- Establish port-based security

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