28/06/2018

Lecture 08 tutorial: Backbone Networks

During tutorials prepare a short report of your activities and show it to your tutor.

Study the following **questions** and verify the correctness of the **answers** if given.
Be aware that the exam question might be directly related to the tutorial questions.

You might like to start with the most demanding **questions 9, 10, 11.**

Question 1.

What are the three technology/design layers important in backbone design?

A

The three backbone design technology layers are...

1. the *access layer* consisting of layer-2 technology of LANs connected to a backbone network (BN)
2. the *distribution layer* as the part of the BN technology that connects the LANs together and containing "TCP/IP gateways" (or, most likely, routers) that are usually located within a single building
3. The *core* layer that connects the different BNs together, often from building to building

Please note that this use of the term "layer" has nothing to do with the 5 layers of the Internet network layer or the 7 layers of the OSI Reference Model.

Question 2.

Explain how routed backbones work.

A

Routed backbones move packets along the backbone based on their network layer address (i.e., layer 3 address). The most common form of routed backbone uses a bus topology (e.g., using Ethernet 100Base-T). Routed backbones can be used at the *core* or *distribution* layers.

At the core layer routed backbones are sometimes called subnetted backbones or hierarchical backbones and are most commonly used to connect different buildings within the same campus network.

At the distribution layer a routed backbone uses routers or layer 3 switches to connect a series of LANs (access layer) to a single shared media backbone network. Each of the LANs are a separate subnet. Message traffic stays within each subnet unless it specifically needs to leave the subnet to travel elsewhere on the network, in which case the network layer address (e.g., TCP/IP) is used to move the packet.

Question 3.

Where are routed backbones most commonly used?

A

Routed backbones are most commonly used to connect different buildings within the same campus network, i.e., at the core layer.

Question 4.

Explain how switched backbones work.

A

Switched backbone networks use a star topology with one device, usually a switch, at its center. The traditional backbone circuit and set of routers or bridges is replaced by one switch and a set of circuits to each LAN.

The collapsed backbone has more cable, but fewer devices. There is no backbone cable. The "backbone" exists only in the switch, which is why this is called a collapsed backbone.

The original collapsed backbone technology uses layer-2 switches and suffers some disadvantage due to the load of data link layer overhead message traffic and limitations on network segmentation. As this weakness has been recognized, collapsed backbone technology is adapting by evolving to the use of layer-3 switches to overcome these problems. The result is better performance and improved network management capabilities for switched backbone networks.

Collapsed backbones are probably the most common type of backbone network used in the distribution layer (i.e., within a building). Most new building backbone networks designed today use collapsed backbones. They also are making their way into the core layer as the campus backbone, but routed backbones still remain common.

Question 5.

Explain how single-switch VLANs work.

A

In a *single switch VLAN* the VLAN operates only inside one switch. The computers on the VLAN are connected into the one switch and assigned by software into different VLANs. The network manager uses special software to assign the dozens or even hundreds of computers attached to the switch to different VLAN segments. The VLAN segments function in the same way as physical LAN segments; the computers in the same VLAN act as though they are connected to the same physical switch or hub.

Question 6.

Explain how multi-switch VLANs work.

A

A multi-switch VLAN works the same way as a single switch VLAN, except that several switches are used to build the VLANs. The switches must be able to send packets among themselves in a way that identifies the VLAN to which the packet belongs. There are two approaches to this: packet encapsulation and modifying the Ethernet packet.

- In the encapsulation approach a proprietary protocol encapsulates the packet. When a packet needs to go from one VLAN switch to another VLAN switch, the first switch puts a new VLAN packet around the outside of the Ethernet packet. The VLAN packet contains the VLAN information and is used to move the packet from switch to switch within the VLAN network.. When the packet arrives at the final destination switch, the VLAN packet is stripped off and the unchanged Ethernet packet inside is sent to the destination computer.
- In the modification approach the Ethernet packet itself is to modified to carry the VLAN information. 16-bytes of VLAN information (according to emerging standard IEEE 802.1q) are added to the standard Ethernet (IEEE 802.3) packet. The additional VLAN information is used to move the packet from switch to switch within the VLAN network. The original Ethernet packet is restored from the modified packet at the final destination switch and then sent to the destination computer.

Question 7.

What is IEEE 802.1q?

A

IEEE 802.1q is a standard that inserts 16-bites of VLAN information into the normal IEEE 802.3 Ethernet packet. When a packet needs to go from one VLAN switch to another VLAN switch, the first switch replaces the incoming Ethernet packet with an 802.1q packet that contains all the information in the original 802.3 Ethernet packet, plus 16-bytes of VLAN information. The additional VLAN information is used to move the packet from switch to switch within the VLAN network. When the packet arrives at the final destination switch, the IEEE 802.1q packet is stripped off and replaced with a new Ethernet packet that is identical to the one with which it entered the VLAN.

Question 8. .

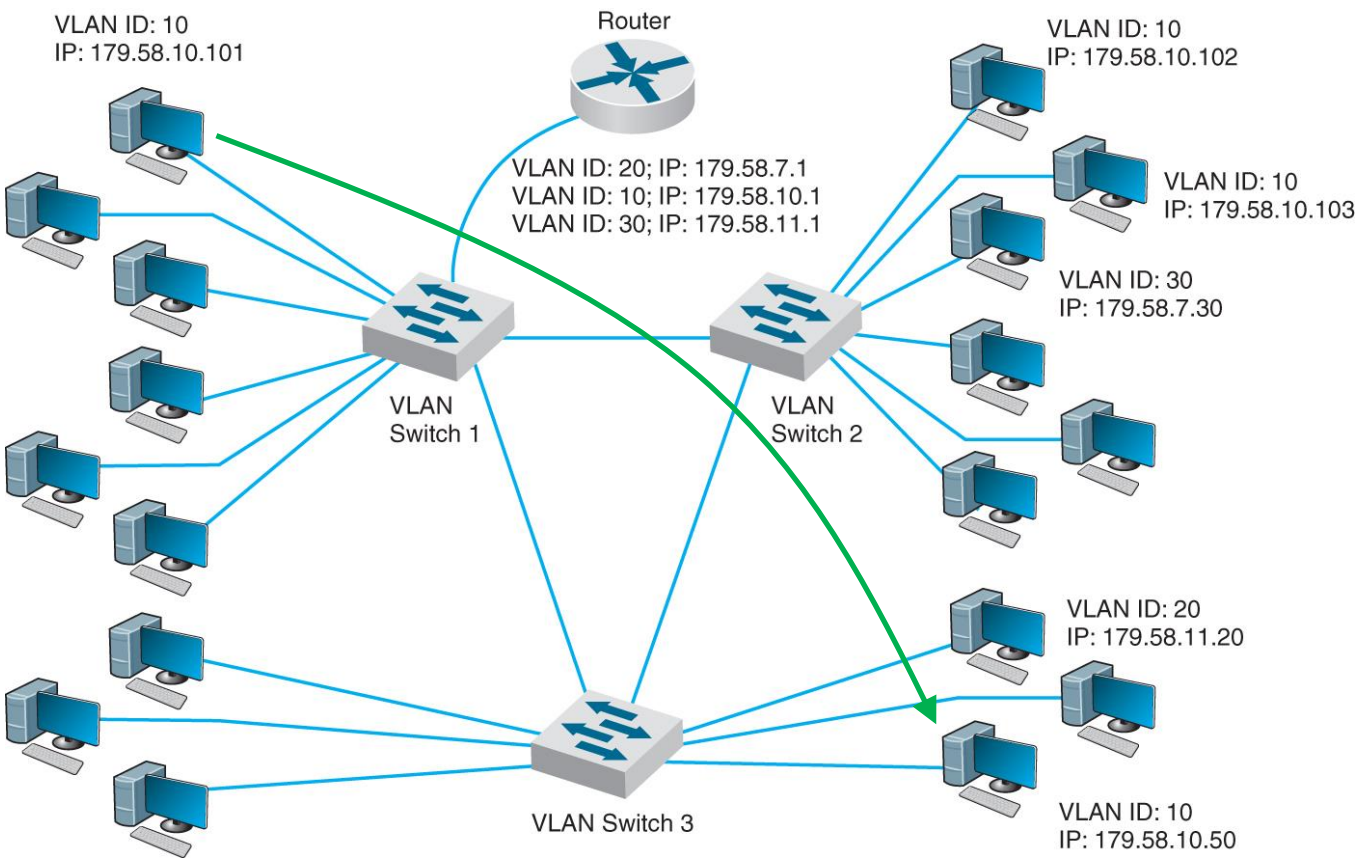
Explain how broadcast messages like ARP are processed in a VLAN

A

Slides 38, 39

Question 9. .

Consider an example of a multi-switch Virtual Local Area Network (VLAN) presented below.



- Assume that a computer with an IP address **179.58.10.101** (switch 1) sends a packet to a computer with an IP address **179.58.10.50** (switch 3).
- Assume that the **179.58.10.101** PC has just been switched on and does not now any MAC addresses.

  a) Give a step by step explanation of the flow of packets/Ethernet frames and

  b) draw the related IP/Eth/1Q packets (add MAC addresses to the involved devices)

A

Consult lecture notes

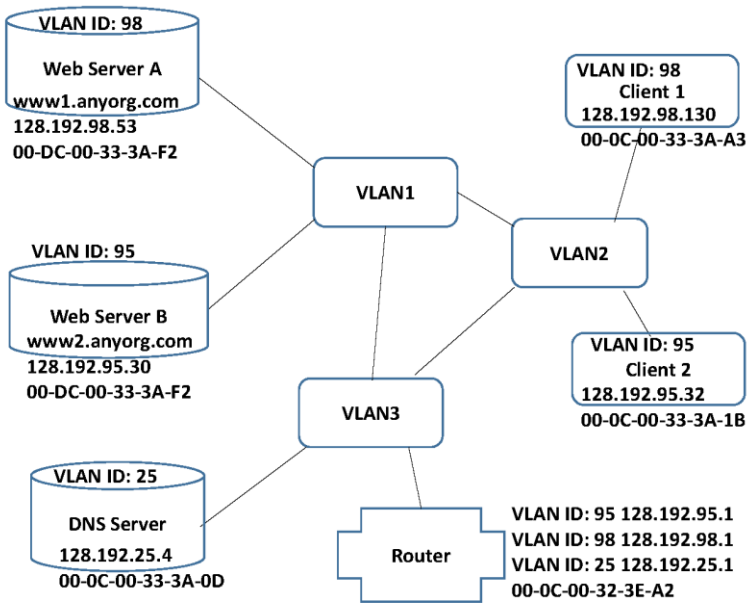
Question 10. .

Consider the example of a routed network as in slide 29

Rearrange and draw the network using three VLAN switches as in slide 23 and similar.

Answer:

The network below includes basic features of a routed network as in slide 29 and distributes the elements of the networks between three VLAN switches.



Question 11. .

For the modified VLAN based network **consider and draw the flow of packets** as in three cases presented in **Lecture 6, slides 10 to 16,** namely:

- Case 1a: Known Address, Same Subnet (e.g. Client 2 to web server B)
- Case 1b: HTTP response to client
- Case 2: Known Address, Different Subnet (e.g. Client 1 to web server B)
- Case 3: Different Subnets, Unknown Addresses (e.g. Client 1 to web server B)

Question 12. .

How VLAN switches create their forwarding tables?

A.

Slides 40, 41