

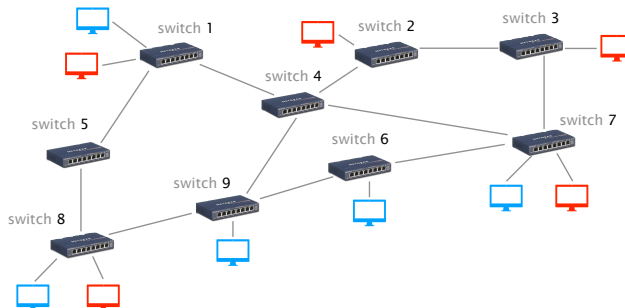
## Communication Networks

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### Exercises week 6 - VLAN, Internet Protocol & Forwarding

#### VLAN

The network below consists of 9 switches and hosts in two different VLANs (blue and red). Compute a spanning tree in the network using switch 1 as root. Indicate the type of each link (trunk, access or deactivated).



L2-network with hosts in two different VLANs (blue and red).

- Using the previously computed spanning tree, which path will the red host connected to switch 7 use to communicate with the red host connected to switch 1?
- Using the previously computed spanning tree, which path will the red host connected to switch 7 use to communicate with the blue host connected to switch 8?
- Compute now two per-VLAN spanning-trees (one for each VLAN) such that each link is active in at least one spanning-tree.

## IPv4 vs. IPv6

- a) In the lecture you heard about IPv4 and IPv6. Why was IPv6 introduced? What is the main difference?
- b) How many IPv4 and IPv6 addresses exist? Is it possible to use all the addresses for hosts in the Internet?
- c) Assuming there are 7.5 billion people in the world, how many IPv4/IPv6 addresses are theoretically available per person?
- d) Even though IPv6 has been standardized more than 10 years ago, it still has very limited coverage. What are the reasons why the deployment of IPv6 is so slow?

## IP Calculations

Each row in the following table describes an IP network. Fill in the missing values.

Slash-notation	Netmask-notation	First usable address	Last usable address	Broadcast address
10.0.0.0/24				
126.127.128.0/17				
	12.34.32.0/255.255.224.0			
		222.208.0.1	222.223.255.254	
		123.45.67.225		123.45.67.255

IPv6 addresses have a slightly different notation. Because the addresses are 128 bit long, we switch from a decimal notation to a hexadecimal one. In general, IPv6 addresses are represented by eight colon-separated blocks of up to four hexadecimal digits each. In a block, leading zeros can be omitted. Furthermore, we can use the "::" symbol to compress one or more consecutive zero blocks. However, the "::" symbol can only be used once in a single IPv6 address. As an example, the IPv6 address: 2001:0db8:0000:0000:0000:ff00:0042:8329 can be simplified to 2001:db8::ff00:42:8329.

- a) You are the operator of an enterprise network. Your ISP is giving you a /96 subnet 2001::/96. How many addresses do you have available? Is that a reasonable subnet size compared with the currently available IPv4 addresses?

**b)** In your enterprise network, each host machine is identified by a unique ID starting from 1. Now that you have a lot of IPv6 addresses available, you decide to give each host a unique IP address. The host with ID 1 gets the first IPv6 address in your subnet (2001::1), the host with ID 2 the second IP address and so on. Complete the following table:

IPv6 address	host ID
	5
	14
2001::3A5	
	4 294 967 295
2001::3:0	

## Detective work

You just started your first job as a network operator of a small network. To get more familiar with the network, you look at a packet trace captured at a switch. The trace contains packets from multiple hosts and one router connected by a (layer 2) switch. The router acts as default gateway, providing access to the Internet and is assigned the first IP address in the subnet. Each row in the following table represents one packet observed at the switch.

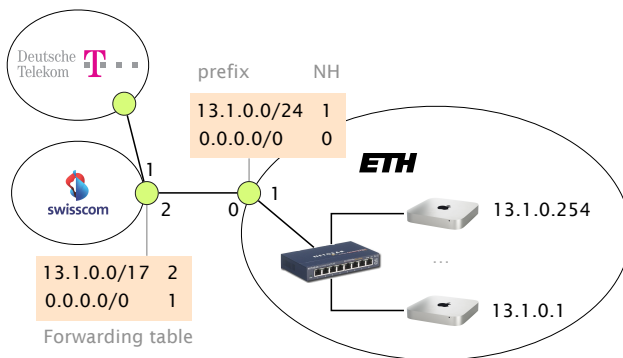
SRC MAC Address	DST MAC Address	SRC IP Address	DST IP Address
6a:00:02:49:a1:a0	11:05:ab:59:bb:02	192.168.11.1	192.168.8.2
6a:00:02:49:a1:a0	da:15:00:00:01:11	192.168.11.1	192.168.16.1
da:15:00:00:01:11	11:05:ab:59:bb:02	129.132.103.40	192.168.8.2
11:05:ab:59:bb:02	40:34:00:7a:00:01	192.168.8.2	192.168.15.254
11:05:ab:59:bb:02	ac:00:0a:aa:10:05	192.168.8.2	192.168.9.99
ac:00:0a:aa:10:05	01:05:3c:34:00:02	192.168.9.99	192.168.13.255
6a:00:02:49:a1:a0	da:15:00:00:01:11	192.168.11.1	192.168.8.1

**a)** Can you identify all the hosts that are part of the local network?

**b)** Can you reconstruct the IP subnet used to address the hosts within that local network?

## The Art of Defaulting Properly (Exam Style Question)

Consider this simple network configuration between ETH and Swisscom. Assume that ETH owns a large IP prefix 13.1.0.0/17, but only uses 13.1.0.0/24 to address its internal hosts. For simplicity, we assume that ETH and Swisscom operators configure their forwarding table statically and rely on the use of a default route (0.0.0.0/0).



Where are my IP packets going?

- How many IP addressable addresses does ETH “own” in total?
- Give the first and last IP address that ETH can use for addressing a host.
- Suppose Swisscom receives a packet for 13.1.0.66 from Deutsche Telekom. What is the path taken by this IP packet?
- Suppose Swisscom receives a packet for 13.1.66.1 from Deutsche Telekom. What is the path taken by this IP packet?
- What eventually happens to the packet for 13.1.66.1? As an attacker observing this, could you use this observation to congest the ETH-Swisscom link more easily? Explain why (or why not).