Communication Networks

Spring 2022

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https://comm-net.ethz.ch/

ETH Zürich

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Communication Networks

Exercise 4

- General information
- Last week’s exercise
- Important lecture topics
- Introduction to this week’s exercise
- Time to solve the exercise

Reminder group registration

Please register your groups for the routing project:
https://comm-net.ethz.ch/registration/php/index.php

Use the #group_search channel on Slack if you
look for other group members (also check #routing_project).
Still around 25 enrolled students without a group

Let us know via Slack or email if there are any problems

The routing project starts next week

Quick introduction during the lecture on Monday

You will get detailed information via GitLab on Monday

In addition to the theoretical assignment,
you can also use the Thursday sessions to work on the project

If needed we will announce additional Q&A sessions

Routing Project Connectivity Fäscht

When	Thursday, 07.04.2022, 18:00–21:30
Where	HG E7
Main topics	Awakening of the mini-Internet connecting all groups/ASes together Interesting demos and detailed explanations Great possibility to work on the project a lot of TAs will support you
Attendance	Not mandatory... but try to make it

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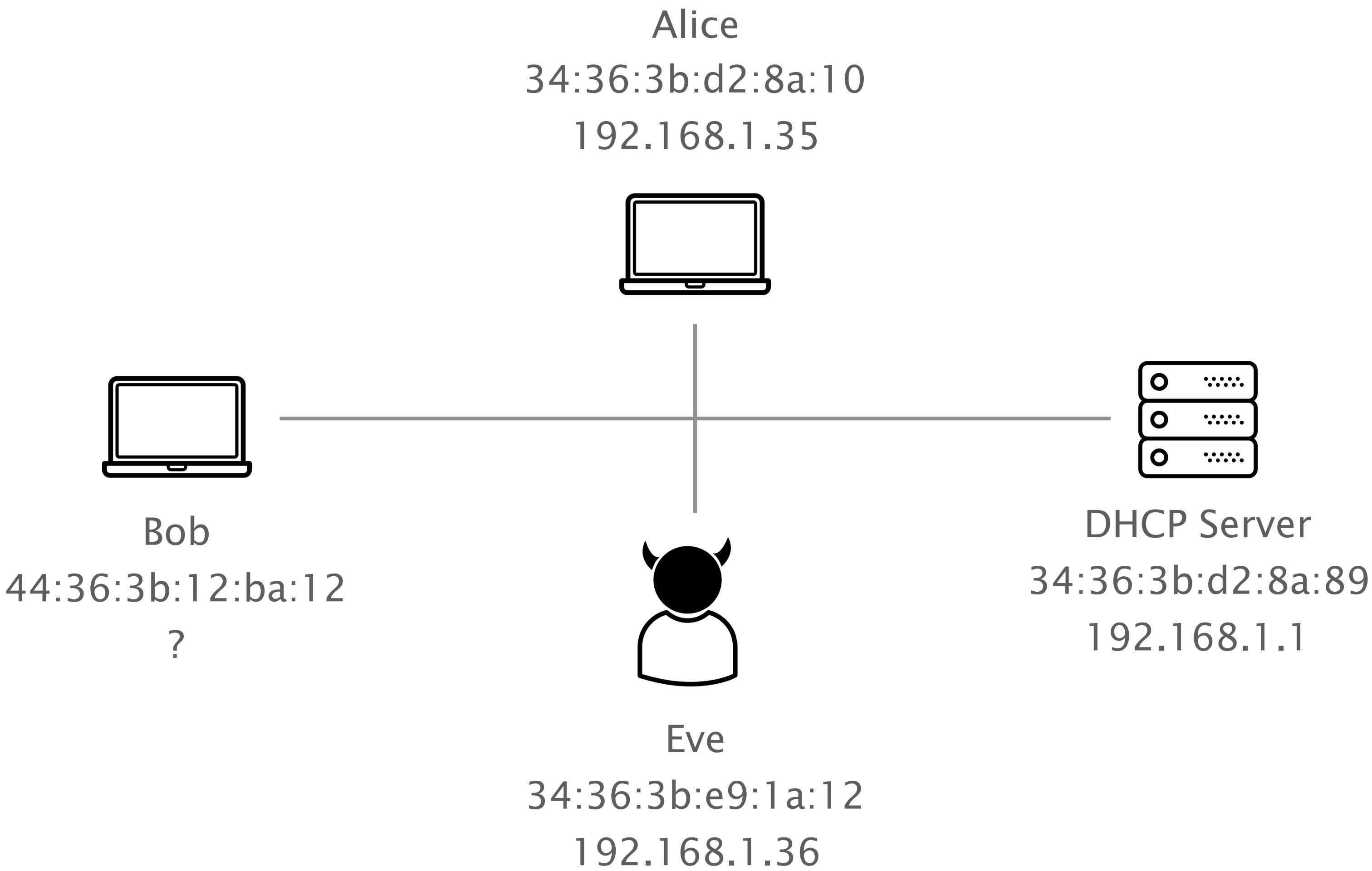
Questions to exercise 3.4 - Imposter



The solutions show an extended DHCP process compared to the lecture slides

SRC MAC address	DST MAC address	Message type	Message content
44:36:3b:12:ba:12	ff:ff:ff:ff:ff:ff	DHCP discovery	I need an IP address
34:36:3b:d2:8a:89	44:36:3b:12:ba:12	DHCP offer	use 192.168.1.37
44:36:3b:12:ba:12	ff:ff:ff:ff:ff:ff	DHCP request	I want the offered IP
34:36:3b:d2:8a:89	44:36:3b:12:ba:12	DHCP ack	Lease duration & configuration
44:36:3b:12:ba:12	ff:ff:ff:ff:ff:ff	ARP request	Who has 192.168.1.35 Tell 192.168.1.37
34:36:3b:d2:8a:10	44:36:3b:12:ba:12	ARP reply	192.168.1.35 is at 34:36:3b:d2:8a:10

We let the DHCP server know that we accept the offer

Why do we broadcast the DHCP request?

SRC MAC address	DST MAC address	Message type	Message content
44:36:3b:12:ba:12	ff:ff:ff:ff:ff:ff	DHCP discovery	I need an IP address
34:36:3b:d2:8a:89	44:36:3b:12:ba:12	DHCP offer	use 192.168.1.37
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34:36:3b:d2:8a:10	44:36:3b:12:ba:12	ARP reply	192.168.1.35 is at 34:36:3b:d2:8a:10

Why do we broadcast the DHCP request?

Discovery is broadcasted to find a (all) DHCP server(s) in the network

SRC MAC address	DST MAC address	Message type	Message content
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34:36:3b:d2:8a:89	44:36:3b:12:ba:12	DHCP offer	use 192.168.1.37
44:36:3b:12:ba:12	ff:ff:ff:ff:ff:ff	DHCP request	I want the offered IP
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34:36:3b:d2:8a:10	44:36:3b:12:ba:12	ARP reply	192.168.1.35 is at 34:36:3b:d2:8a:10

The request is also broadcasted to inform **all** DHCP servers which offer was picked. This way, the servers from which we did **not** take the offer can reuse the corresponding IP.

Why do we broadcast the DHCP request?

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DHCP offer and ack are unicasted in the solution we provide but in practice depending on the implementation they can also be broadcasted

How could Bob detect the spoofing attack from Eve?

Very difficult to detect in general

Bob might be suspicious as he receives two ARP replies

But which is the correct one?

Bob could also have a shared secret with Alice

Eve does not know it and cannot react correctly

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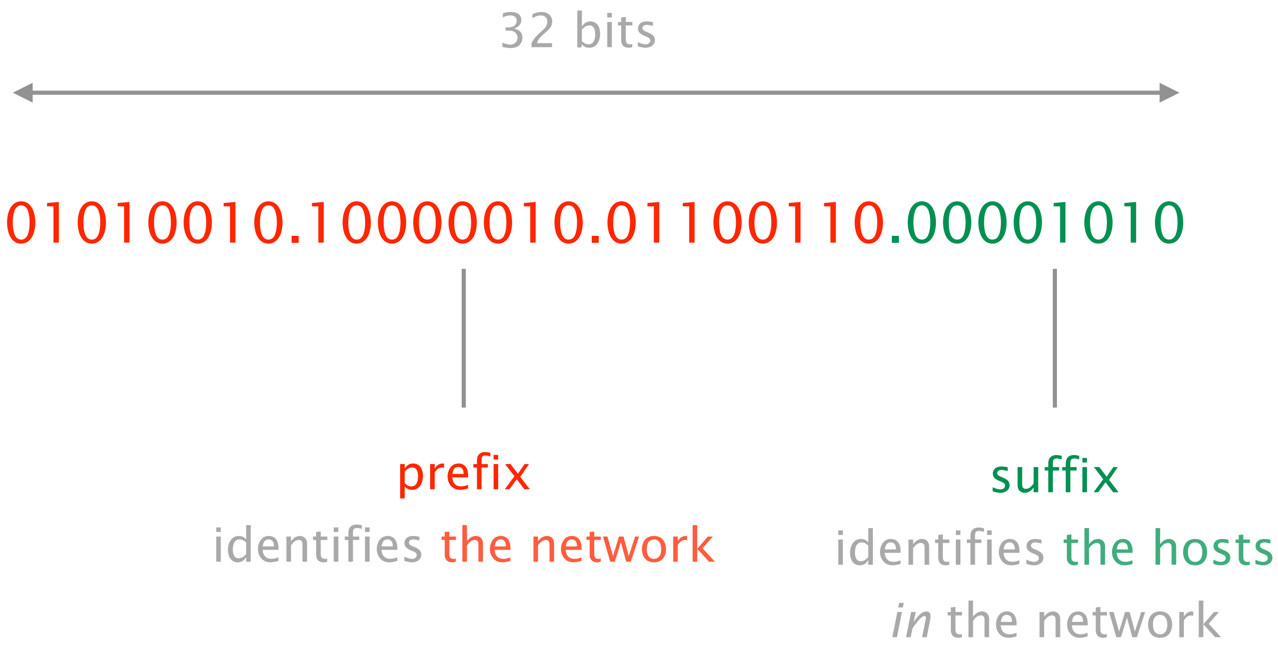
Important IPv4 concepts



Important IPv4 concepts

The address with the host part being all 0s identifies the network itself

The address with the host part being all 1s identifies the broadcast address

Important IPv6 concepts

Notation	8 groups of 16 bits each separated by colons (:)
	Each group is written as four hexadecimal digits
Simplification	Leading zeros in any group are removed
	One section of zeros is replaced by a double colon (::)
	Normally the longest section
Examples	1080:0:0:0:8:800:200C:417A → 1080::8:800:200C:417A
	FF01:0:0:0:0:0:0:0101 → FF01::101
	0:0:0:0:0:0:0:1 → ::1

Let’s look at an example

Given the prefix 153.96.0.0/12

Compute

# of addressable hosts

the prefix mask

network address

1st host address

last host address

broadcast address

Let's look at an example

Given the prefix 153.96.0.0/12

Compute

# of addressable hosts	2 ** (32 - 12) - 2 = 1048574
the prefix mask	11111111.11110000.00000000.00000000
network address	
1st host address	
last host address	
broadcast address	

Let’s look at an example

Given the prefix 153.96.0.0/12

Compute

# of addressable hosts	2 ** (32 - 12) - 2 = 1048574
the prefix mask	11111111.11110000.00000000.00000000
network address	153.96.0.0
1st host address	153.96.0.1
last host address	
broadcast address	

Let's look at an example

Given the prefix 153.96.0.0/12

Compute

# of addressable hosts	2 ** (32 - 12) - 2 = 1048574
the prefix mask	11111111.11110000.00000000.00000000
network address	153.96.0.0
1st host address	153.96.0.1
last host address	153.111.255.254
broadcast address	153.111.255.255

Let's look at an example

Given the prefix 153.96.0.0/12

Compute

# of addressable hosts	2 ** (32 - 12) - 2 = 1048574
the prefix mask	11111111.11110000.00000000.00000000
network address	153.96.0.0
1st host address	153.96.0.1
last host address	153.111.255.254
broadcast address	153.111.255.255

You can always look at it on a bit level

Given the prefix 153.96.0.0/12

153.96.0.0	10011001.01100000.00000000.00000000
the prefix mask	11111111.11110000.00000000.00000000
broadcast address	all host bits are 1
	10011001.01101111.11111111.11111111
	153.111.255.255

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Task 4.1 & 4.2: Related to Spanning Trees

initially

Each switch proposes itself as root
sends (X,0,X) on all its interfaces

Upon receiving (Y, d, X), checks if Y is a better root
if so, considers Y as the new root, flood updated message

Switches compute their distance to the root, for each port
simply add 1 to the distance received, if shorter, flood

Switches disable interfaces not on shortest-path

Task 4.1 & 4.2: Related to Spanning Trees

tie-breaking

Upon receiving ≠ BPDUs from ≠ switches with = cost

Pick the BPDU with the lower switch sender ID

Upon receiving ≠ BPDUs from a neighboring switch

Pick the BPDU with the lowest port ID (e.g. port 2 < port 3)

Task 4.1 & 4.2: Related to Spanning Trees

most relevant

tie-breaking

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Task 4.1 & 4.2: Related to Spanning Trees

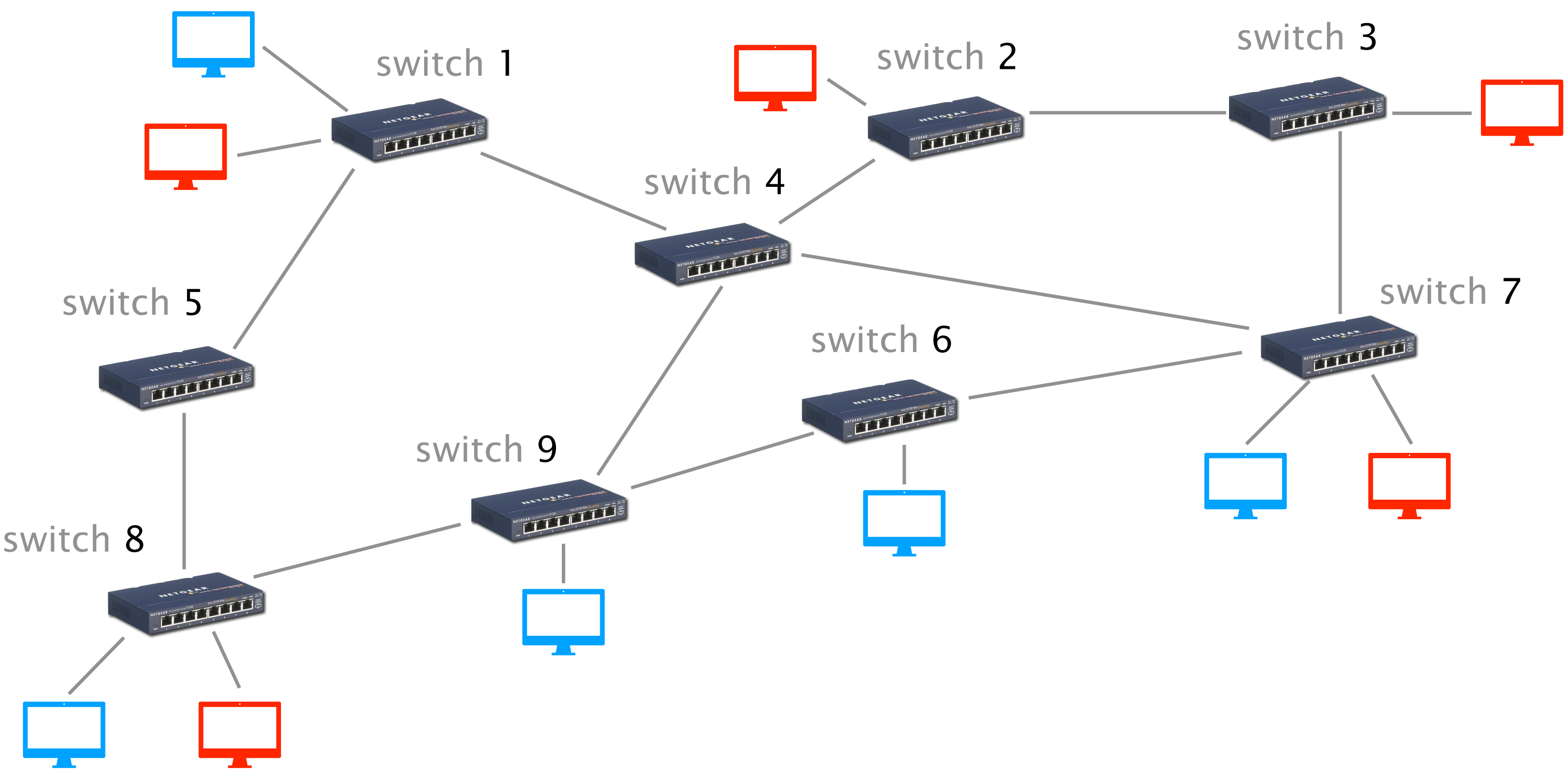
hint

Compared to a switch in the network,
you already have knowledge of the entire topology

I.e., you immediately know which switch
will eventually be the root of the spanning tree

Start from the root rather than thinking
about all the individual BPDU messages

Task 4.3: VLAN



More details: Slides 92-113 (week 4)

Task 4.4 - 4.6: Related to IPv4 and IPv6 computations

Please perform the computations by hand!

Do not use a calculator/online tools

It is essential for the exam that you can do such computations without additional help

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