

Communication Networks

Spring 2019 — Exercise 4



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Communication Networks

This Exercise Session



Questions and important information

Overview about the current assignment

Time for you to solve the tasks & ask questions

Solutions will be published next week

Questions and important information

Please register your group for the routing project

[Link on Slack / on the website](#)

Build groups of three students

First practical project starts next week

Introduction during the lecture

Use e.g., Slack to find other students without a group

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Task 4.1 & 4.2: Focus on Spanning-Tree

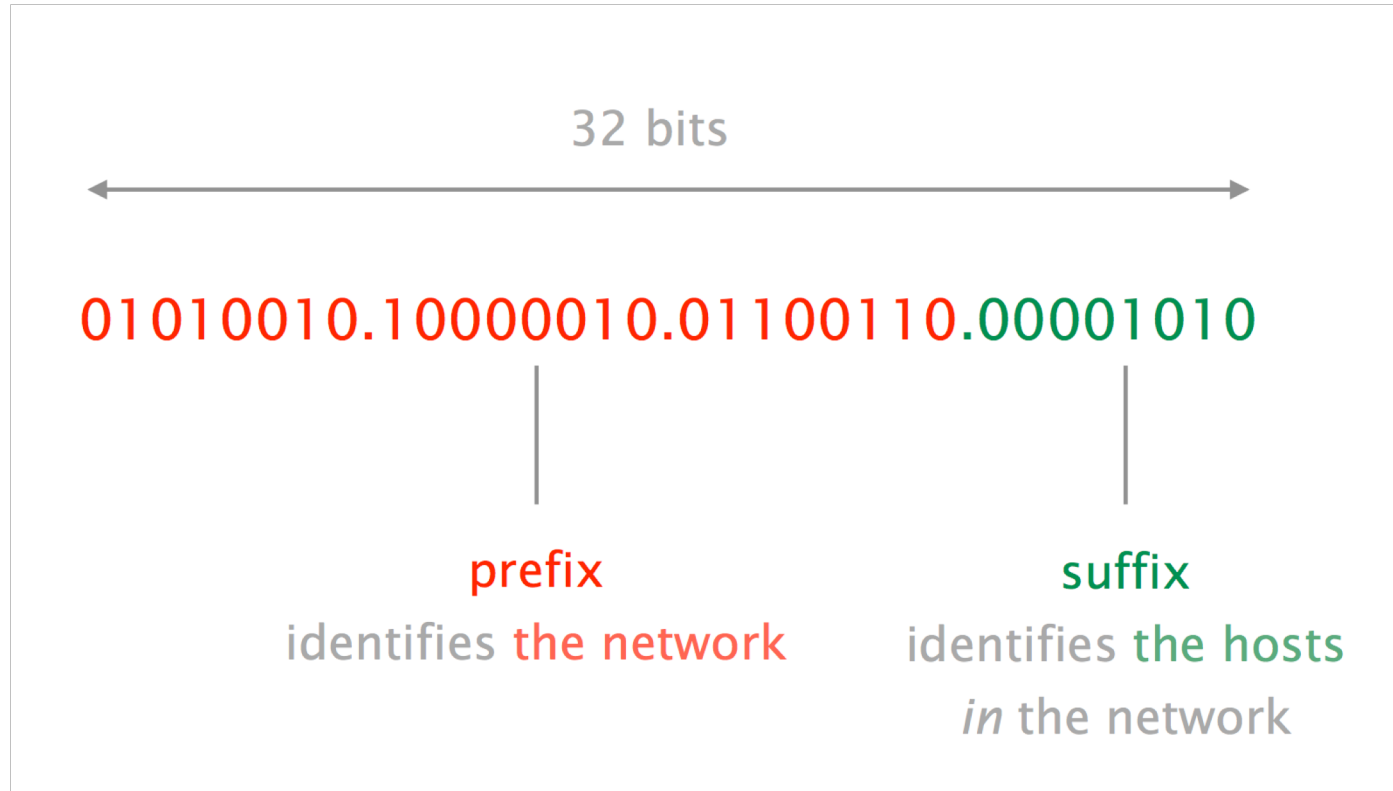
Algorithm on the slides

Important: tie-breaking based on lower sender switch ID

What happens if two switches have the lowest ID?

Traffic engineering, e.g. by changing switch IDs

Task 4.3: IPv4 & IPv6 Calculations



Please do not use any tools/programs for the calculations!

Task 4.4: Detective work

Given a packet trace, identify local hosts and IP subnet

A network with one router as default gateway

The first IP in the subnet is assigned to the router

Remember: "internal" communication goes over layer 2

Task 4.5: **Exam question** from 2018

Simplify a forwarding table – least number of entries

Forwarding behavior should be **equivalent** to initial table

Forwarding decision based on **longest prefix match**

A lot of students had trouble with this question

Will discuss solution techniques at the end of the session

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Task 4.5: Partial solution discussion

Two main **simplification approaches**:

- Replace multiple prefixes with a larger one
- Exploit longest prefix match behavior

Possible **pitfalls**:

- Some IPs are forwarded to a different next-hop
- The new table covers more IPs than the old one

Example 1: Replace prefixes

111.222.0.0/24

111.222.1.0/24

111.222.2.0/23

Example 1: Replace subnets

111.222.0.0/24

111.222.1.0/24

111.222.2.0/23



111.222.0.0/23

Example 1: Replace subnets

111.222.0.0/24

111.222.1.0/24

111.222.2.0/23



111.222.0.0/23

111.222.2.0/23



111.222.0.0/22

Example 2: Exploit longest prefix match

prefix	next-hop
111.222.0.0/20	1
111.222.16.0/20	2
111.222.32.0/20	1
111.222.48.0/20	1

Example 2: Exploit longest prefix match

prefix	next-hop		
111.222.0.0/20	1		
111.222.16.0/20	2		
111.222.32.0/20	1		111.222.32.0/19
111.222.48.0/20	1		1


Example 2: Exploit longest prefix match

prefix	next-hop		
111.222.0.0/20	1	111.222.0.0/20	1
111.222.16.0/20	2	111.222.16.0/20	2
111.222.32.0/20	1		
		111.222.32.0/19	1
111.222.48.0/20	1		

Are we done?

Example 2: Exploit longest prefix match

prefix	next-hop		
111.222.0.0/20	1		
111.222.16.0/20	2	111.222.0.0/18	1
111.222.32.0/20	1	111.222.16.0/20	2
111.222.48.0/20	1		



Example 2: Exploit longest prefix match

prefix	next-hop		
111.222.0.0/20	1		
111.222.16.0/20	2	111.222.0.0/18	1
111.222.32.0/20	1	111.222.16.0/20	2
111.222.48.0/20	1		

Longest prefix match!

Back to the actual exercise

Step 1: Identify important part of prefix

prefix	next-hop
82.130.32.0/20	1
82.130.64.0/20	1
82.130.80.0/20	2
82.130.96.0/20	1
82.130.112.0/21	1
82.130.120.0/21	1
82.130.122.0/24	1
82.130.123.0/24	1
82.130.124.0/24	2

Step 1: Identify important part of prefix

prefix	next-hop
82.130.32.0/20	1
82.130.64.0/20	1
82.130.80.0/20	2
82.130.96.0/20	1
82.130.112.0/21	1
82.130.120.0/21	1
82.130.122.0/24	1
82.130.123.0/24	1
82.130.124.0/24	2

Step 2: A binary representation can help

prefix	next-hop
82.130.32.0/20	1
82.130.64.0/20	1
82.130.80.0/20	2
82.130.96.0/20	1
82.130.112.0/21	1
82.130.120.0/21	1
82.130.122.0/24	1
82.130.123.0/24	1
82.130.124.0/24	2

Step 2: A binary representation can help

prefix	third octet (binary)	next-hop
82.130.32.0/20	0010 0000	1
82.130.64.0/20	0100 0000	1
82.130.80.0/20	0101 0000	2
82.130.96.0/20	0110 0000	1
82.130.112.0/21	0111 0000	1
82.130.120.0/21	0111 1000	1
82.130.122.0/24	0111 1010	1
82.130.123.0/24	0111 1011	1
82.130.124.0/24	0111 1100	2

Step 3: Reduce number of prefixes

prefix	third octet (binary)	next-hop
82.130.32.0/20	0010 0000	1
82.130.64.0/20	0100 0000	1
82.130.80.0/20	0101 0000	2
82.130.96.0/20	0110 0000	1
82.130.112.0/21	0111 0000	1
82.130.120.0/21	0111 1000	1
82.130.122.0/24	0111 1010	1
82.130.123.0/24	0111 1011	1
82.130.124.0/24	0111 1100	2

Step 3: Reduce number of prefixes

prefix	third octet (binary)	simplification	next-hop
82.130.32.0/20	0010 0000		1
82.130.64.0/20	0100 0000		1
82.130.80.0/20	0101 0000		2
82.130.96.0/20	0110 0000		1
82.130.112.0/21	0111 0000	82.130.112.0/20	1
82.130.120.0/21	0111 1000		
82.130.122.0/24	0111 1010	82.130.122.0/23	1
82.130.123.0/24	0111 1011		
82.130.124.0/24	0111 1100		2

Step 3: Reduce number of prefixes

prefix	third octet (binary)	simplification	next-hop
82.130.32.0/20	0010 0000		1
82.130.64.0/20	0100 0000		1
82.130.80.0/20	0101 0000		2
82.130.96.0/20	0110 0000	82.130.96.0/19	1
82.130.112.0/21	0111 0000		
82.130.120.0/21	0111 1000		
82.130.122.0/24	0111 1010	82.130.122.0/23	1
82.130.123.0/24	0111 1011		
82.130.124.0/24	0111 1100		2

Step 3: Reduce number of prefixes

Continue in the same way...

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