NTNU - Department of Information Security and Communication Technology

TTM4240 - Semester Assignment 1: IPv4 and Routing

Learning objectives:

- Find and fix faults in an existing network configuration.
- Understand basic router (FRR and VyOS) and host configuration.
- Understand IPv4 addressing and subnetting.
- Understand routing with OSPF and BGP.
- Explain your findings.

Due date: 03.09.2026

For this lab assignment, you will need to use a local GNS3-client to interact with a GNS3-server, running on a VM accessed through OpenVPN. Instruction on how to connect to the server are provided in a wiki which can be found here: `https://pages.git.ntnu.no/ie-iik/ttm4240-web/latest/wiki/Setup/`**. We will update the wiki based on your feedback and questions on a regular basis. You will be working in the GNS3 virtual environment. FRR, VyOS and switch images are provided.**

Guidelines:

- You are advised to start as early as possible with the assignment tasks and use the tuition hours to ask about unclear or ambiguous parts in this assignment. We advise you to read the whole task first before starting to work on it.
- Ensure the work done gets preserved. You can work with a router's configuration in two ways:
  - ensure selected router is stopped, open its configuration file via context menu ("Edit config"), edit and save it
  - or start selected router and introduce changes via its console. Do not forget to make your changes permanent: execute **write** command in the terminal, or your changes are going to be lost after the router's restart
- List of the useful FRR and VyOS commands that you might want to use can be found in NTNU Wiki: `https://pages.git.ntnu.no/ie-iik/ttm4240-web/latest/wiki/`. Other relevant FRR commands can be found in: `https://docs.frrouting.org/en/latest/basic.html`. Other relevant VyOS commands can be found in: `https://docs.vyos.io/en/rolling/cli.html`.
- You should deliver an export of your completed project as part of the report. Be patient when exporting the project file from GNS3 and uploading it to Canvas. Don't interrupt it while it's uploading to Canvas. It takes some time, but tends to work out in the end.
- Note that all VMs are restarted at 04:00 each night. Make sure to save your files before that time.
- When using packet-capture to inspect traffic, remember to stop the capture when you've gathered enough information.

Submission details:

Please submit an archive (.tar.gz or .zip) containing a directory, which contains all files you want to submit. Please have your group number in the file name and the directory name. Submission is to be done via Canvas, one attempt per group. A report (one single PDF file, named *worksheet(num)-group(num).pdf*) containing the following elements is mandatory:

- Your group number on the first page.
- For each question, the written answers with the **relevant** portions of output from all commands in text format. Screenshots of terminal windows are accepted, but try to keep this at a minimum with only necessary pictures. For ping 3-4 lines of ping requests is sufficient.
- For each question all **changed** parts in the configuration of routers and hosts (differences to the default config).
- **Never** include the full verbatim switch or router configuration in the pdf report.
- For all questions, state your assumptions, say what you did, describe what you observed, explain your conclusions.

Additionally, please include any scripts you've used to collect or plot data in the archive. For each question where you edited the default configurations, please provide the full router configurations in a separate text file named after the device and question, e.g.: q01-config-R1.txt. This makes it easier for us to reproduce your configuration and understand what you did. Preferably, provide the full configurations using the VyOS commands format:

```
show configuration commands
```

We can only grade what we find in your submission and what we understand. Please state your assumptions and observations as clearly as possible.

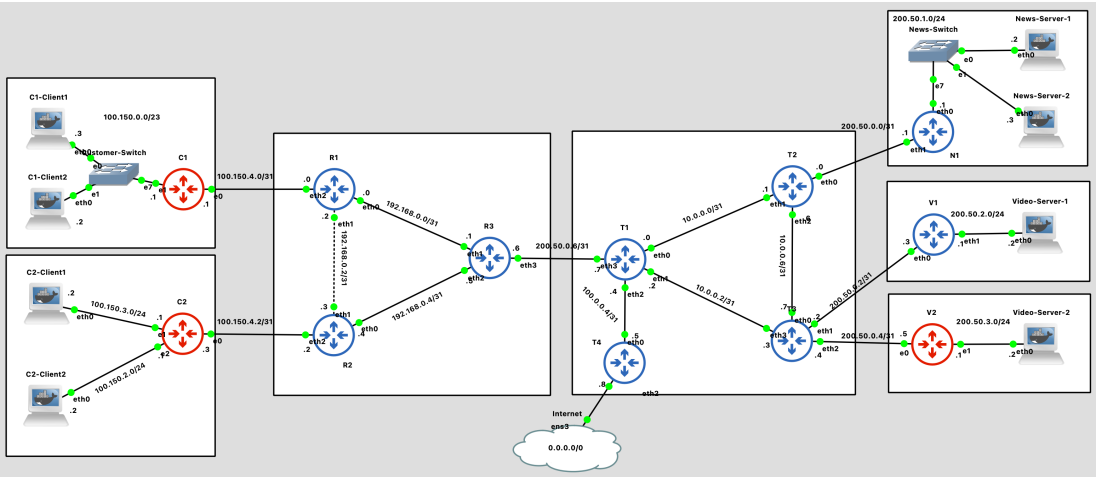


Figure 1: Topology for Assignment 1.

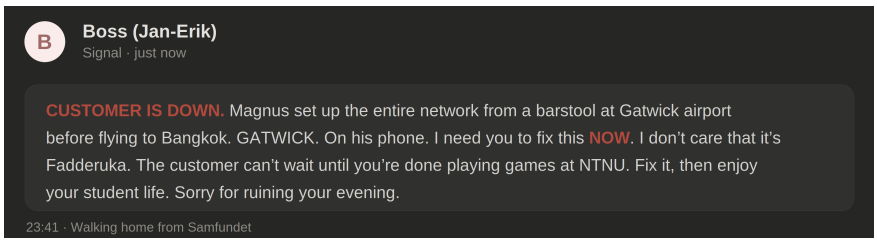
Part 1: Debugging

It's Wednesday night. Fadderuka is in full swing. You have a drink in your hand, you know maybe six people's names, and for the first time since moving to Trondheim you actually feel like you might belong here. Someone just invited you to a cabin trip next weekend. Things are going well.

You say your goodbyes and step out into the September drizzle. Shoes wet, tired, already thinking about your pillow. Halfway home your phone buzzes. Signal notification. You check it assuming it's someone from the group chat.

Ohh no... it's Jan-Erik. Your boss at the network engineering firm where you work part-time. You had specifically taken the whole week off, your first week as a student, Fadderuka, something you'd been looking forward to all summer. Jan-Erik had agreed.

You stop walking.



You stand there in the rain for a second. Then you keep walking, get home, drop your bag, and crack open the laptop.

Magnus is a good engineer. Really, he is. But nobody should be touching production configs from a phone at an airport bar. The network is a mess... eight things are broken, and none of them are obvious. The customer is watching streams that aren't loading. Jan-Erik is super stressed sending messages every 10 minutes. Magnus is somewhere over Asia, blissfully asleep.

It's just you now.

Task

There are **8 faults** in the network configuration. Find and fix all of them. The network must be fully operational when you are done.

Use show commands, compare configs against the topology, and document what you find and what you change.

#	Node	Hint
01	Video-Server-1	The video servers are unreachable, but the network otherwise looks OK. The host cannot reach outside.
02	T4	One of the transit routers cannot reach anything in the core.
03	T4	Same router as above - it is trying to peer with a neighbor but failing.
04	T3	One of the customer-facing routers can never reach V1. Check the basics.
05	T3	Customer prefixes are never advertised to external peers.
06	T3	A transit router still can't reach T2 via OSPF, even after other bugs are fixed.
07	T2	An entire customer network is unreachable from the rest of AS4.
08	T1	No routes from an entire external AS are showing up.

Table 1: The 8 faults.

Part 2: Forensics

The **8 faults** are fixed. The network is running. But you're curious.

You are now working as a junior network engineer at the regional ISP (AS3). Nothing is broken. The task is to understand the network you have inherited. You will dig into show output and explain what you find.

Rules:

- Run the commands yourself in the lab.
- Answer the questions based on your own output, not the topology diagram.
- Show the command sequence you used to arrive at your answer.

You can use AI along the way. What matters is that you understand the answers you get.

Task 1: Map AS3 without the topology diagram

Run on R1, R2, and R3:

```
show ip ospf neighbor
```

Questions:

1. How many routers are in AS3? What are their OSPF router-IDs?
2. Which column in the output tells you over which local interface the adjacency is established?

Task 2: BGP peer inventory on R3

Run on R3:

```
show bgp summary
```

Questions:

1. Mark in the output which peers are iBGP and which are eBGP. What does the `remote-as` value tell you?
2. Is any peer in state `Active` or `Idle` ? What would that indicate?

Task 3: Read an AS path from scratch

Run on R1:

```
show bgp ipv4 unicast 200.50.3.0/24
```

Questions:

1. Write out the full AS path for this route. Reading right to left, which AS originated the prefix?

2. What does each AS number in the path represent? Which nodes in the topology do they correspond to?
3. What is the `Next Hop` address? Is this an iBGP- or eBGP-learned next-hop?
4. What does the origin code `i` at the end of the line mean? What would `?` or `e` mean instead?