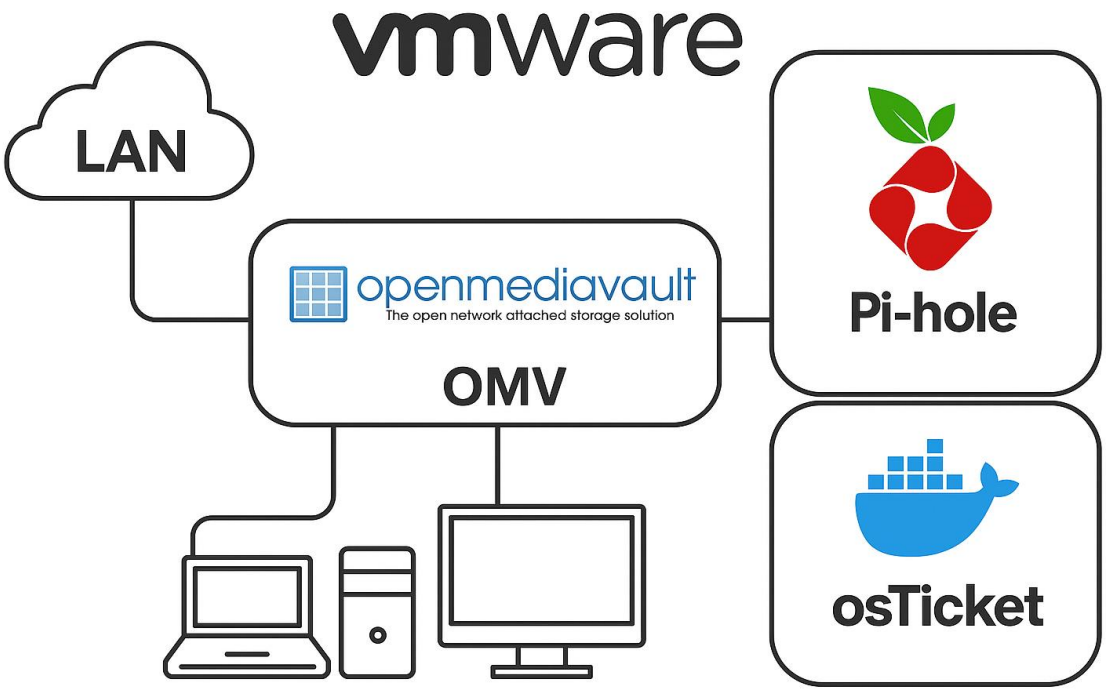
Introduction to infrastructures

Assignments 2025 - 2026

Template report



Student number:	
Name:	
Class:	

SAXION UNIVERSITY OF APPLIED SCIENCES

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Contents

Important Guidelines

1. **Screenshot Identification:**
   Make sure your screenshots clearly show that they are your own work. Wherever possible, include a visible identifier such as your name, student number, or your operating system's username in each screenshot. This helps confirm the authenticity of your assignment.
2. **Use of External Sources and AI Tools:**
   If you use information from the internet, books, articles, or AI tools such as ChatGPT, Copilot, or similar, you must provide valid APA references for all such sources. This includes both directly copied and paraphrased content.

Any suspicions of plagiarism, including failure to cite sources properly, will be forwarded to the examination board for review.

APA in-text citation examples:
According to ChatGPT, APA citations must include author, year, title, and source (OpenAI, 2025a). When planning system requirements for Linux users, it's important to account for both memory and GPU needs (OpenAI, 2025b).

These are examples of in-text citations. They refer to the matching entries in the reference list.

Reference List example
OpenAI. (2025a, June 22). *ChatGPT response about APA citations*. ChatGPT. https://chat.openai.com/

OpenAI. (2025b, June 18). *ChatGPT response about Linux system requirements*. ChatGPT. https://chat.openai.com/

Note: The letters **a** and **b** after the year are used to distinguish between different references from the same source or author published in the same year.

Include your reference list at the end of this report.

Week 0 – Preparation assignments

Task 0.1: Read the business case

- See assignments document Chapter 0.

Task 0.2: Download the required ISOs

- Debian 12: https://www.debian.org/CD/netinst/
- Ubuntu 24.04 Desktop: https://cdimage.ubuntu.com/noble/daily-live/current/

Task 0.3: Install VMware

- Read this blogpost: https://www.mikeroysoft.com/post/download-fusion-ws/
- Register at www.broadcom.com
- Download & Install the newest version of VMware Workstation Pro or VMware Fusion Pro

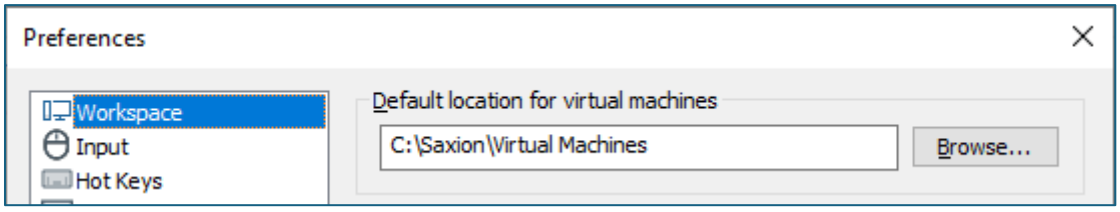
Task 0.4: Folders

- Create a folder called **Saxion** on your biggest and fastest(ssd) hard drive
- Create a subfolder called **ISO** in the Saxion folder
    - Copy the downloaded ISOs into the **ISO** folder
- Create another subfolder called **Virtual Machines** in the Saxion folder

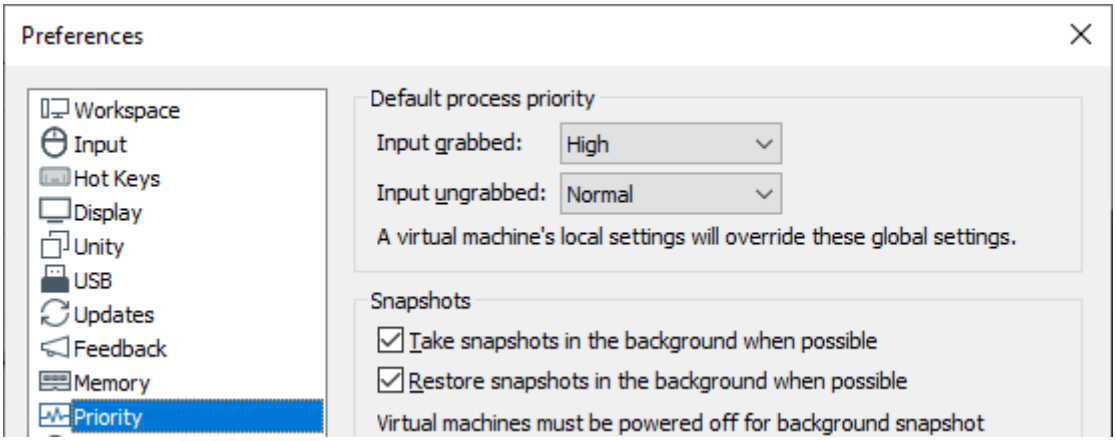
Task 0.5: VMware Preferences

Once VMware is installed edit the preferences of VMware.

Set Default location for virtual machines to the **Virtual Machines** folder you've created.



Set priority on High if the Input is grabbed.



Click on the OK button.

Task 0.6: What is the Open Media Vault?

Do research and find out what the Open Media Vault is. Focus specifically on file sharing. We want to implement this system for the municipality of Enschede. Then fill in the quality requirements table below. What do you think the quality requirements should be for this system. Fill in the **Requirement** and **Explanation** columns.

Information System	Quantity requirement	Requirement	Explanation:
Open Media Vault – File sharing			
Performance Efficiency			
	Time Behaviour	Satisfactory, Good, Excellent	
	Resource Demand	Low, Medium, High	
	Scalability	Low, Medium, High	
Reliability			
	Availability	In %	
	Recovery Point Objective (RPO).	In hours or days	
	Recovery Time Objective (RTO) (Recoverability)	In hours or days	
	Fault Tolerance (double output)	Yes/No	
Security			
	Data encryption (data at rest)	Yes/No	
	Data encryption (data in transit)	Yes/No	
	Access with authentication	Yes / No	
	If Yes what form of authentication(s)	Username password, MFA, external authentication (e.g. Digid)	
	Publicly accessible via the Internet	Yes / No	
	If yes: readonly or full access		
Portability			
	Must information system be portable to other hardware or cloud provider	Yes/No	

Week 0 Preparation: Proof that you did the assignments above

Put screenshots of the Saxion folder structure here:

Put screenshots that you've installed VMware and that you've changed the preferences here:

You have filled in the quality requirements table: YES/NO

Week 1 – Setting up a client/server architecture

Task 1.1: Setup the network in VMware

Correctly setup the Virtual Network in VMware. Follow the instructions in chapter 1 of the assignments document.

Task 1.2: Install Debian 12

Install Debian 12 following the instructions in chapter 1 of the assignments document.

Task 1.3: Install Open Media Vault

Install Open Media Vault following the instructions in chapter 1 of the assignments document.

Task 1.4: Install Ubuntu 24.04 Desktop

Install Ubuntu 24.04 Desktop in VMware following the instructions in chapter 1 of the assignments document.

Task 1.5: What is Nextcloud?

Do research and find out what Nextcloud is. Focus specifically on the office collaboration tools of Nextcloud. We want to implement this system for the municipality of Enschede. Then fill in the quality requirements table below. What do you think the quality requirements should be for this system. Fill in the **Requirement** and **Explanation** columns.

Information System	Quantity requirement	Requirement	Explanation:
Nextcloud – office collaboration tools			
Performance Efficiency			
	Time Behaviour	Satisfactory, Good, Excellent	
	Resource Demand	Low, Medium, High	
	Scalability	Low, Medium, High	
Reliability			
	Availability	In %	
	Recovery Point Objective (RPO).	In hours or days	

	Recovery Time Objective (RTO) (Recoverability)	In hours or days	
	Fault Tolerance (double output)	Yes/No	
Security			
	Data encryption (data at rest)	Yes/No	
	Data encryption (data in transit)	Yes/No	
	Access with authentication	Yes / No	
	If Yes what form of authentication(s)	Username password, MFA, external authentication (e.g. Digid)	
	Publicly accessible via the Internet	Yes / No	
	If yes: readonly or full access		
Portability			
	Must information system be portable to other hardware or cloud provider	Yes/No	

Week 1: Proof that you did the assignments above

Screenshots of your Virtual Machines in VMware also showing your host OS user name:

Screenshots of Ubuntu Firefox web browser, connecting to the Open Media Vault website:

- With the static IP of the Open Media Vault:

- With the domain name of the Open Media Vault:

You have filled in the Nextcloud quality requirements table: YES/NO

Week 2 – Adding disks and setting up file shares

Task 2.1 Add two hard disks to the Debian Open Media Vault VM

Follow the instructions in chapter 2 of the assignment document

Task 2.2 Setup a BTRFS file system and RAID 1 for redundancy

Follow the instructions in chapter 2 of the assignment document

Task 2.3 Setup shared folder on the Open Media Vault

Follow the instructions in chapter 2 of the assignment document

Task 2.4 Setup SMB/CIFS Services

Follow the instructions in chapter 2 of the assignment document

Task 2.5 Setup user rights

Follow the instructions in chapter 2 of the assignment document

Task 2.6 Test shared folder access

Follow the instructions in chapter 2 of the assignment document

Week 2: Proof that you did the assignments above

Screenshot of your Ubuntu VM accessing the shared folder on the Open Media Vault:

Screenshot of the Open Media Vault Web Gui with the shared folder configuration:

Week 3 – Deploying docker applications

Task 3.1: Setup docker on the Open Media Vault

Follow the instructions in chapter 3 of the assignment document.

Task 3.2: Setup macvlan network for docker

Follow the instructions in chapter 3 of the assignment document.

Task 3.3: osTicket docker app

Follow the instructions in chapter 3 of the assignment document.

Task 3.4: Access osTicket on Ubuntu VM

Follow the instructions in chapter 3 of the assignment document.

Week 3: Proof that you did the assignments above

Screenshot that your Ubuntu VM Firefox browser can use the osTicket web app:

Week 4 – Setting up Pi-hole as local DNS server

Task 4.1: Pi-hole docker compose file

Follow the instructions in chapter 4 of the assignment document.

Task 4.2: Going into the Pi-hole docker container via the terminal

Follow the instructions in chapter 4 of the assignment document.

Task 4.3: Pi-hole Web Gui setup

Follow the instructions in chapter 4 of the assignment document.

Task 4.4: Network settings for clients using Pi-hole

Follow the instructions in chapter 4 of the assignment document.

Task 4.5: Hardware advice

a) Eventually, Open Media Vault (OMV) needs to be installed on a bare metal server to serve as a reliable and efficient network-attached storage (NAS) solution. Considering the intended use in a municipal setting, with requirements for data integrity, uptime, scalability, and future-proofing provide the municipality of Enschede with a well-justified recommendation on which server hardware they should purchase. Your advice should take into account the performance needs of OMV and hardware compatibility. The municipality of Enschede only purchases servers from reliable well-known brands like **Dell**, **HP** or **Lenovo**. Clearly explain why your chosen bare metal server is an adequate and well-suited choice to run OMV for the municipality of Enschede.

b) The Municipality of Enschede is migrating to a Linux desktop environment and will be using either Ubuntu 24.04 Desktop or Linux Mint 22. There are 1500 employees, divided into three distinct groups:

- Office Users (1000 employees): These employees mainly use standard office applications such as word processing, spreadsheets, email, and web browsing.
- GIS Users (400 employees): These users regularly work with large 3D drawings related to buildings and underground infrastructure (e.g., pipelines). They edit and save these drawings using GIS and CAD applications.
- Mobile Users (100 employees): This group includes aldermen and city councillors who frequently travel and work without a fixed workstation. They require access to documents, email, and centrally stored files while on the move.

The municipality only purchases desktops, laptops, or tablets from reliable, well-known brands such as **Dell**, **HP**, or **Lenovo**.

What hardware would you recommend for each of these three groups? Use the **SMART** criteria (**S**pecific, **M**easurable, **A**chievable, **R**elevant, **T**ime-bound) to describe your hardware choices for each group.

Week 4: Proof that you did the assignments above

Screenshot that your Ubuntu VM Firefox browser can reach the osTicket web app with its domain name:

Screenshot of the Pi-hole Web Gui local DNS Records settings:

Your hardware advice for the Open Media Vault Server:

Your hardware advice for the three distinct groups of employees:

Week 5 – Backups & Security

Task 5.1: System backup

Follow the instructions in chapter 5 of the assignment document.

Task 5.2: Docker backup

Follow the instructions in chapter 5 of the assignment document.

Task 5.3: Nmap open ports scanner

Follow the instructions in chapter 5 of the assignment document.

Task 5.4: Backups

Install Déjà Dup and Timeshift on the Ubuntu Desktop. Make backups of personal files and make system snapshots. Follow the instructions in chapter 5 of the assignment document.

Task 5.5: Eindhoven University of Technology (TU/e)

Recently the Eindhoven University of Technology (TU/e) was hit by a cyber-attack. The municipality of Enschede wants to learn from this incident. Read the following article and the management summary compiled by Fox-IT. Then complete the following assignment.

Link to article: here

The NIST Cybersecurity Framework (NIST CSF) is organized into five core functions:
Identify, Protect, Detect, Respond, Recover.

Something went wrong during the hack. Which **NIST** functions, must the **TU/e** improve?

NIST Security function:	**Because:**	**What could the TU/e have done to prevent this:**

Week 5: Proof that you did the assignments above

Screenshot of a successful system back-up on Open Media Vault:

Screenshot of an overview of the docker app back-ups on Open Media Vault:

Open Media Vault RPO/RTO advice:

- What RPO/RTO do you suggest for a the system back-up of OMV?
- What RPO/RTO do you suggest for a the docker app back-ups of OMV?

Screenshot of using Nmap on Ubuntu scanning for open ports on the Open Media Vault:

Screenshots of backup and restoration of personal files with Déjà Dup on Ubuntu Desktop:

Screenshots of successful system snapshots with Timeshift on Ubuntu Desktop:

Ubuntu Desktop RPO/RTO advice:

- What RPO/RTO do you suggest for the personal files back-up on Ubuntu with Déjà Dup?
- What RPO/RTO do you suggest for a the system snapshots on Ubuntu with Timeshift?

You have filled in the NIST Security functions table: YES/NO

Week 6 – Cloud

Task 6.1: Nextcloud as Azure VM

Complete the installation of Nextcloud in Azure. Follow the instructions in chapter 6 of the assignment document.

Task 6.2: Include the public IP of Nextcloud in the Pi-hole local DNS

Give the Nextcloud Azure VM a local domain name. Follow the instructions in chapter 6 of the assignment document.

Task 6.3: Install apps in Nextcloud

Install the apps **Calendar**, **Contacts**, and **Talk**. Follow the instructions in chapter 6 of the assignment document.

Task 6.4: Add users to Nextcloud

Add four new users to Nextcloud. Yourself included. Follow the instructions in chapter 6 of the assignment document.

Task 6.5: Nextcloud stress test

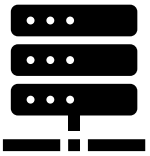
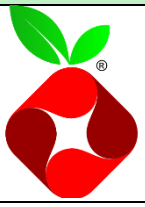
Invite at least three other students to your Nextcloud server. Do the stress test together as a group of four. Follow the instructions in chapter 6 of the assignment document.

Task 6.6: Draw the created infrastructure diagram

Draw the infrastructure that you have created during the past six weeks.

- Use lines to connect all components (e.g., routers, switches, servers, clients).
- Label each component clearly with its name and IP address(IPv4).
- Use the drawing tools in Microsoft Word to create your diagram.
- Use the provided icons from the table below.

Your final diagram should be neat, complete, and accurately reflect your implemented setup.

Router/Switch/Firewall	Server	Internet/Cloud	User laptop
			
User desktop	**osTicket**	**Pi-hole**	**Docker**
			

Task 6.7: Azure VM calculator

Use the Azure pricing calculator to estimate how much the Nextcloud VM would cost per month. Read chapter 6 of the assignment document for technical details of the VM.

Azure pricing calculator: https://azure.microsoft.com/en-us/pricing/calculator/

Week 6: Proof that you did the assignments above

On your Ubuntu VM show that you can connect to the Nextcloud Azure VM in the Firefox web browser by using the custom domain **cloud.enschede.nl**. Put that screenshot here:

Also try the public IP address of the Nextcloud Azure VM. Put that screenshot here:

Screenshots of the working Nextcloud applications **Calendar**, **Contacts**, and **Talk**:

Screenshots and Findings of the Nextcloud stress test:

Diagram of the Network infrastructure:

Azure VM cost estimate for Nextcloud. Paste contents of downloaded Excel sheet in here:

Reference list

Include your APA references here.