Week 1

Introduction to Infrastructures

SAXION
UNIVERSITY OF
APPLIED SCIENCES

Agenda

Introduction Module

What is an IT infrastructure?

Quality requirements Infrastructure

Working on the case

Introduction module

Competencies and learning objectives

We're working on:

- Analyze
- Advise
- Designs
- Realisation

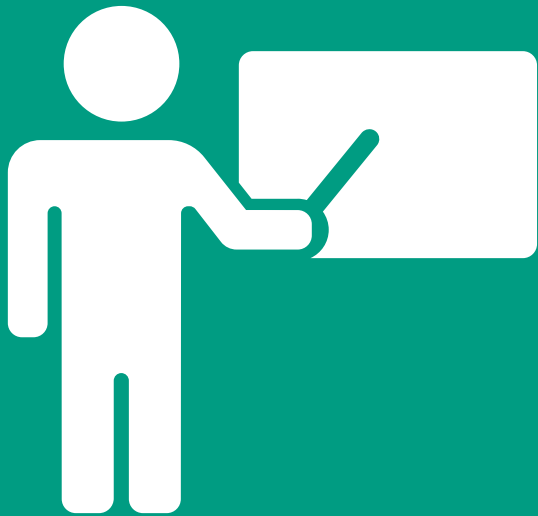of an IT infrastructure at level 1

Learning objectives

- What is an **infrastructure** and which **components** does it consists of

- What **requirements** does it have to meet

- **Advising on** and designing an infrastructure based on a set of **requirements**.

- **Realisation** of a limited part of an infrastructure.

Brightspace

- Module manual

- Course material per week

- Case study

- Rubrics

Assessment

- End product: report of the assignments

- The report will be graded using the rubrics on Brightspace.

Weekly schedule

1 **Introduction quality requirements infrastructure**

2 **Hardware & Virtualization**

3 **Operating Systems & Containers**

4 **Networks**

5 **Backups & Security**
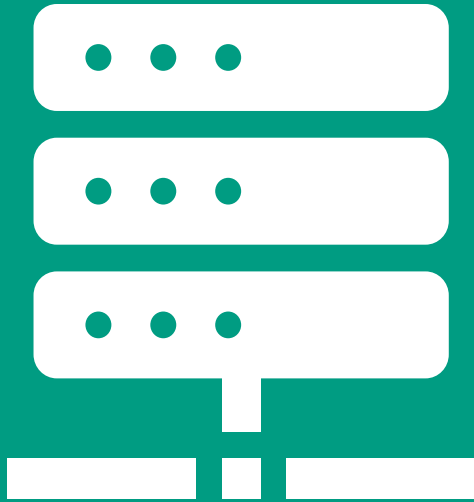
6 **Cloud**

7 **Completion**

Activity

- Examine the brightspace page for the module.

- Main outline of module manual and rubrics is discussed in the classroom.

What is an
IT infrastructure?

IT Infrastructure

A combination of **hardware, software, networks and facilities** (including related equipment)
that are used to **develop, test, deliver, monitor, control or support IT services,**
(Source: ITIL)

Example:
Servers
Databases
Networks
Storage devices
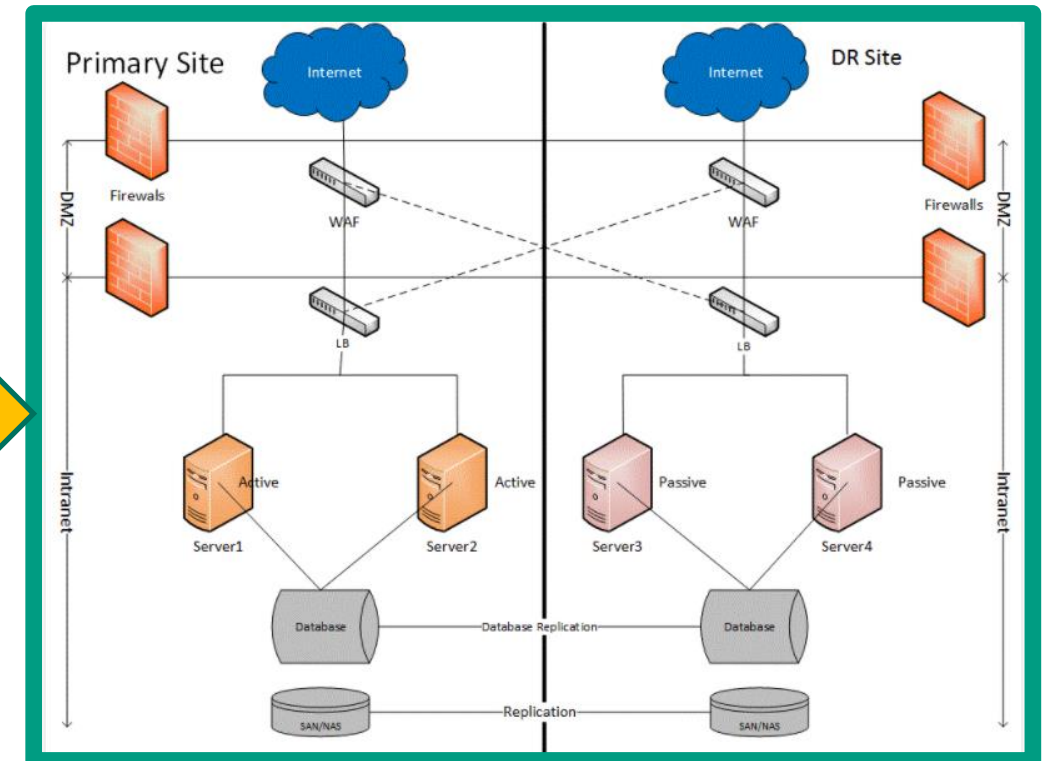Firewalls
Power supply
Cooling

.....

From application to infrastructure

A developer develops an application on a PC.
How do we **deploy** the application so that millions of users can use this application with the requirement:

- Good performance
- Always available
- Safe
- Etc.

Needed: a well designed IT Infrastructure

From application to infrastructure

Sometimes it goes wrong:

Due to the high demand for tickets for the concerts that Adele announced, her website was overloaded on Tuesday morning.

The singer will perform in London's Hyde Park on July 1 and 2, 2022.

Due to the website crash, many fans were unable to pre-register for tickets to the first concerts announced since her comeback.
They received a message that the page was temporarily out of use.
These are the first concerts since her last tour in 2017. She last performed in the Netherlands in 2016. It is not clear whether the international tour will continue in 2022.

Example: Sqills Enschede
Software for selling train tickets

It is **not difficult to build software** for selling thousands of train tickets.
It is difficult to build it so that it can be scaled to process millions of tickets.
It is not just adding more servers.
Our first version of the software dates from 2007.
We have thrown away a lot and learned from our mistakes.
We now have a stable scalable solution that can do thousands of transactions each second.
We continuously work to improve our product.
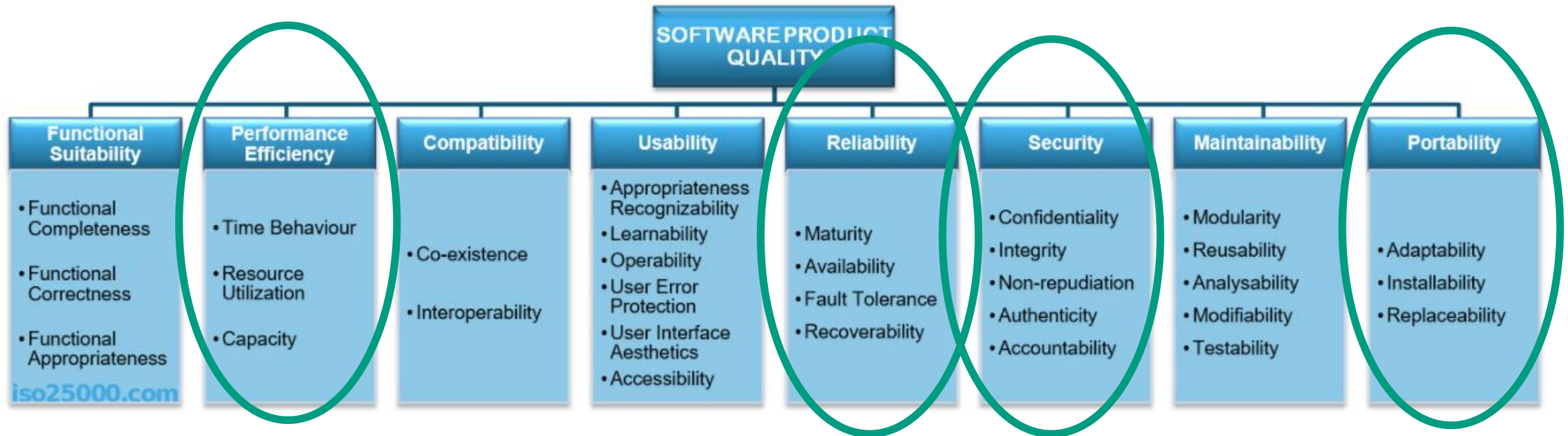
Infrastructure requirements

What requirements do you think of:

- Performance?
- Availability?
- …

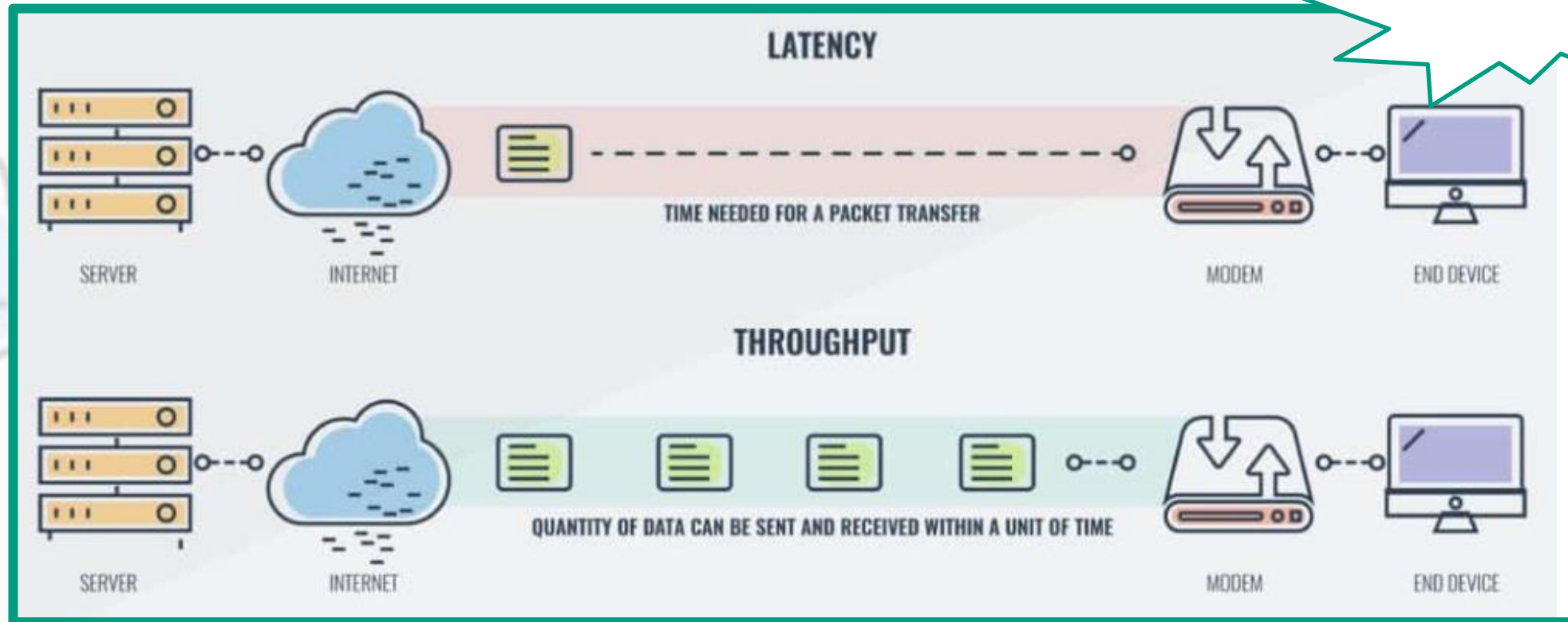- There is a standard that helps us think about those requirements!!

ISO 25010: Standard for software and infrastructure quality

Important parameters

IS A VERY IMPORTANT SUBJECT.

Performance & Efficiency

ping

Time behavior - *The extent to which the response and processing times and throughput rates of a product or system in performing its functions meet the requirements.*

- **Latency** - The time it takes to send a packet through a network. You can measure this as a single trip to the destination or as a return trip.

- **Throughput** - The amount of of data transmitted within a unit of time are sent and received

Example:
What does it cost **Amazon** if their website has a bad performance?

Activity

- Examine the latency of various sites with the tool GTmetrix (gtmetrix.com)

  www.saxion.nl
  www.enschede.nl
  www.ajax.nl
  www.feyenoord.nl
  www.amazon.nl
  ....

Which latency (Time To First Byte (TTFB)) and Fully Loaded Time you find insufficient, sufficient, good or excellent?

Quality Requirements – Time Behavior

Sufficient

- speed of response is not important as long as it does respond.

Good

- system should respond within human patience period i.e. 2 seconds

Excellent

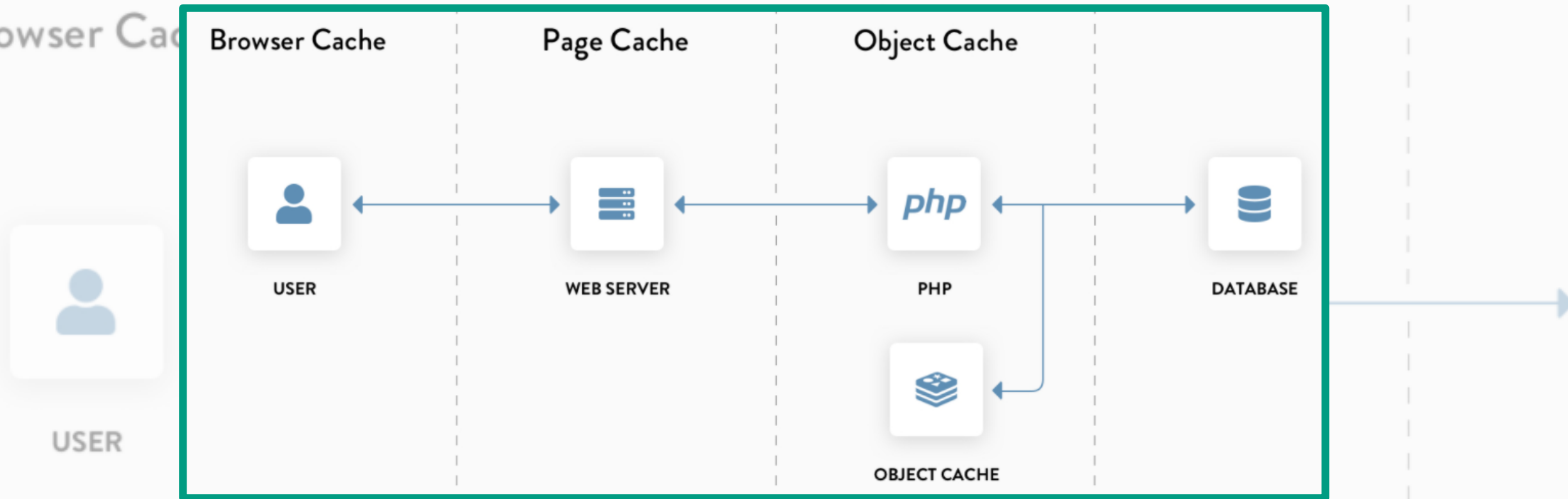- response is required as close as possible to immediately.

Activity

Rank the following sites according to performance you would require from sufficient to excellent:

(sufficient - good - excellent).

Online store:
Amazon.com
Municipality of Enschede
Bison.saxion.nl
Brightspace

Performance & Efficiency

Resource utilization - *The measure of how much of the available resources the system is using.*

Performance & Efficiency

Resource Demand – *How much CPU, RAM and Network traffic an application would put on a server.*

Quality Requirements – Resource Demand

Low

- Minimal resource demand is placed on server especially if servers are set up properly with caching etc...i.e. could run on any basic server.

Medium

- In between low and high.

High

- High demand on servers, would require significant processing / storage or network traffic due to the nature of system.

Note

- We want to waste as few resources as possible.

  This requirement applies to every system.

- Is determined by the application (uses efficient algorithms) but also by the infrastructure (e.g. caching)

Performance & Efficiency

- **Scalability** also helps to waste as few resources as possible.

- **Traditional**: enlarging servers when it seems necessary. Works fine if load can be predicted and is fairly constant.

- **Automatic** scaling: adding or removing servers. Faster scaling up and down. Works well when load is not constant, hard to predict.

- To enable scalability, both the application and the infrastructure must be prepared for this.
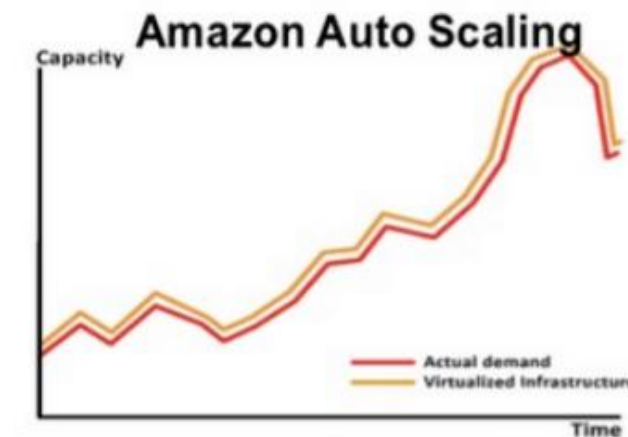
Quality Requirements – need for scalability

Low
- System is unlikely to experience fluctuations of demand.

Medium
- Some change may occur.

High
- Large difference of demand could occur within the systems during different periods or high growth of system usage could occur.

Reliability (Availability, Fault Tolerance, Recoverability)

Availability - The degree to which a system, product, or component is operational and accessible when needed for use.

Measured in %.

Example:

Example:

- What does it cost Amazon when the website is not available for 1 hour?
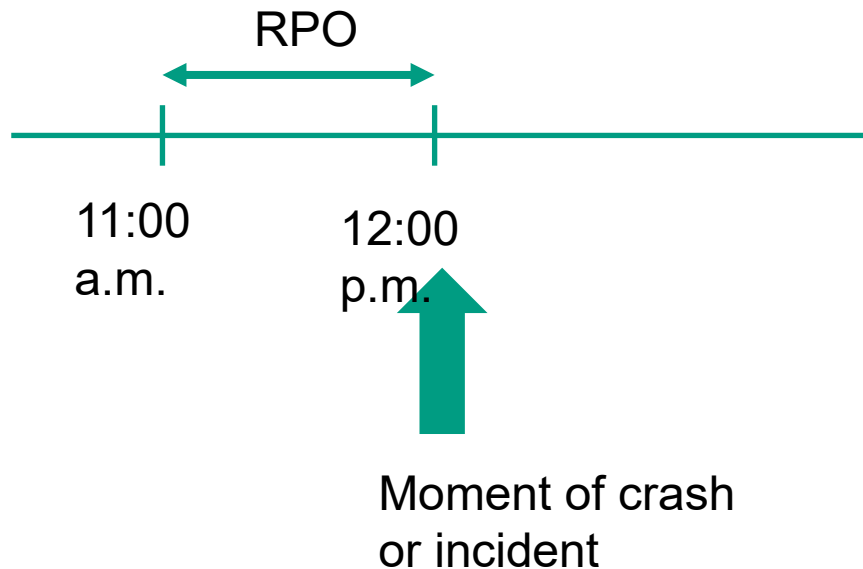
- Or for 1 day?

Not available	Available	Availability
1 hour per year	8759 hours p.a.	99,99%
1 day per year	364 days p.a.	99,72%
1 week per year	51 weeks p.a.	98.07%

Availability

- If unavailable: how much data loss is allowed?

- This is called the RPO: Recovery Point Objective

As given here:

- RPO 1 hour.
- Maximum 1 hour data loss allowed

RPO

11:00 a.m.   12:00 p.m.

Moment of crash or incident

Example:

Is it allowed for Amazon that after a crash the transactions of the last hour are lost?

The smaller the RPO the higher the costs! Why?

Activity

What availability and RPO
do you propose for the following
systems:

- Brightspace Saxion
- Bison Saxion
- Website Saxion
- FC Twente website

- **Please note:** the smaller the
  RPO the more expensive it
  becomes!

Fault tolerance

Fault tolerance - The degree to which a system, product or component functions as intended, despite the presence of hardware or software errors.
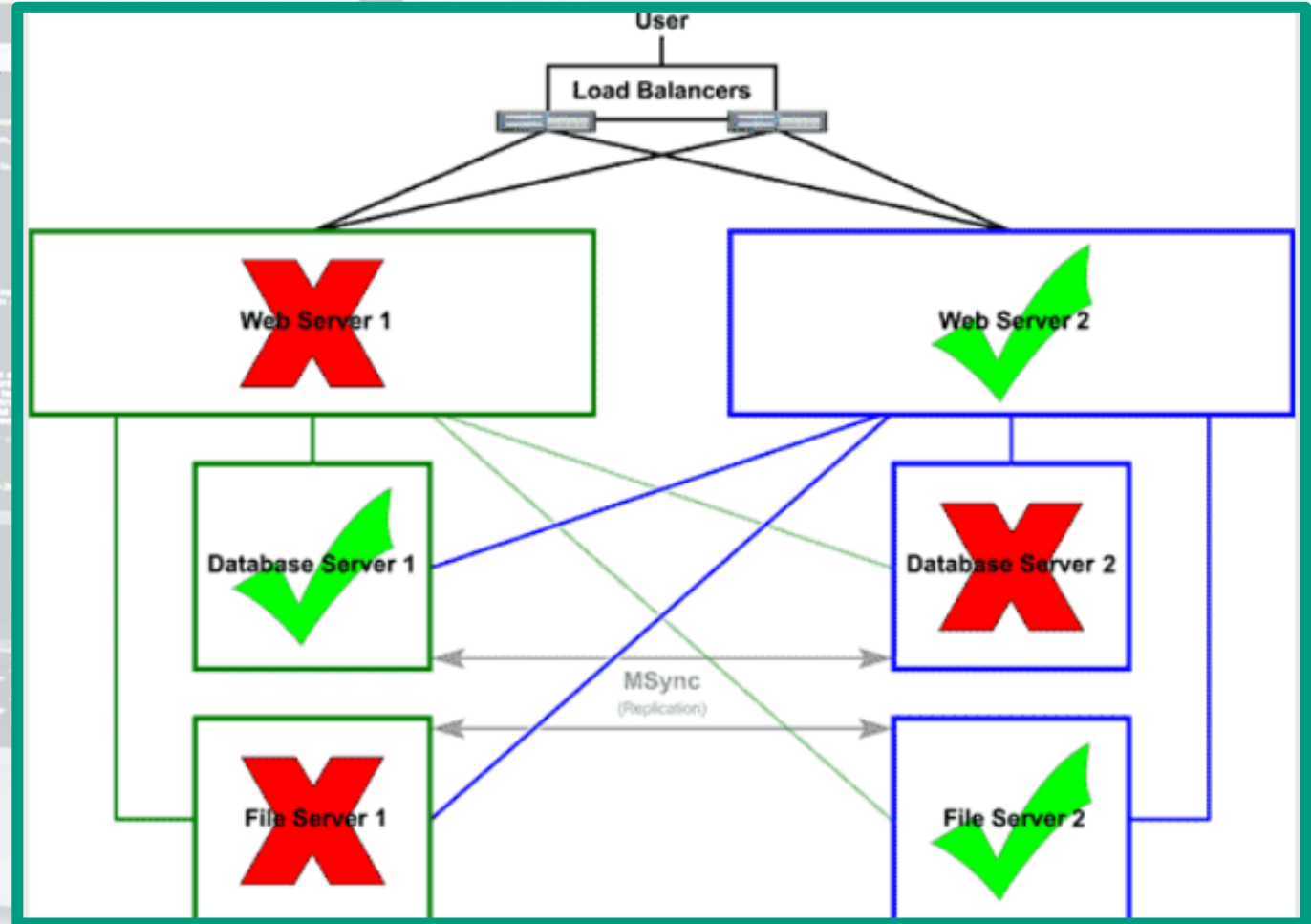
Fault tolerance

- Is closely related to availability.

- To achieve the highest availability: fault tolerance is required. We want to avoid SPOFs (Single Point of Failures).
- **So duplicate parts and components**

Recoverability

- Restoring the system after failure

Recoverability

Recoverability - The degree to which a product or system can recover the affected data directly in the event of an interruption or malfunction and return it to the desired state of the system. The ability of a product or system in the event of an interruption or malfunction to restore data to its intended state.

Defined in RTO (Recovery Time Objective)
How much time after a failure should the the system be available again.

As given here:

- RTO 3 hours.
- Maximum 3 hours available again after the crash

RTO

12:00 p.m.   3:00 p.m.

Moment of crash or incident
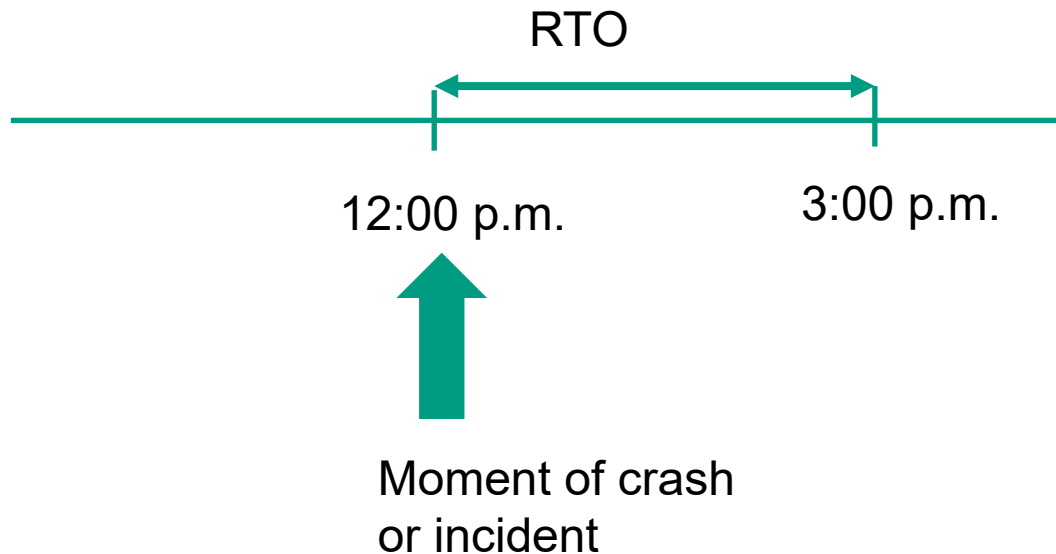
Example:

Suppose system is hacked and data is encrypted. Can system be up again in RTO? All data must be restored from backups or other solution.

The smaller the RTO the more difficult and more costs!
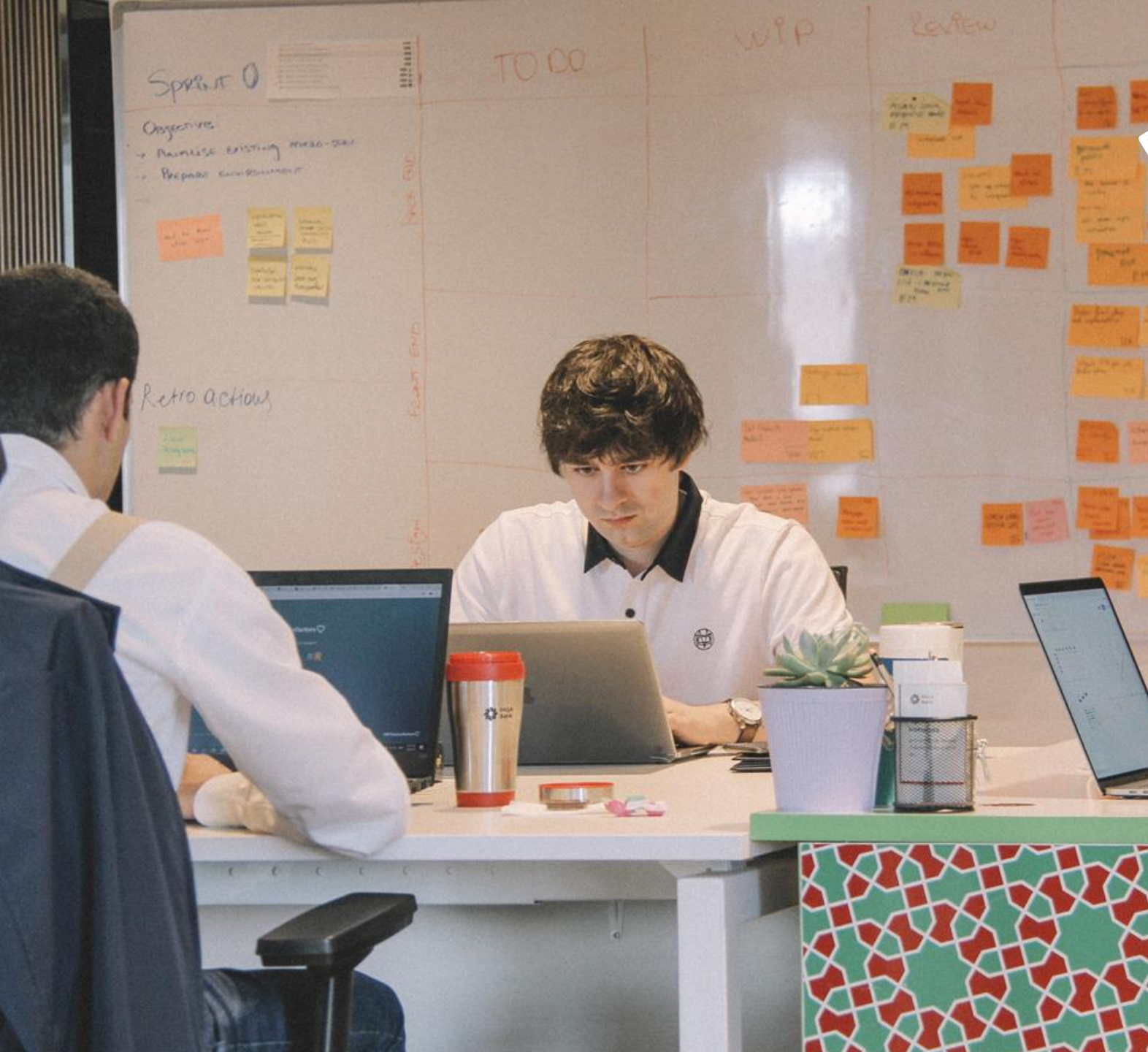
Activity

What RTO do you suggest, for the following systems:

- Brightspace Saxion
- Bison Saxion
- Website Saxion
- FC Twente website

Note: the smaller the RTO the more expensive it gets!

Security

Confidentiality - *The degree to which a product or*
system ensures that information
*is accessible only to those who should have access.*

MFA

- Access control.
- Important questions:
  - Is access only allowed after login?
  - If yes: login with username/password
    or also MFA (Multi Factor Authentication)
  - Is access permitted from the internet

Security: integrity

Important questions:

- Should data be encrypted?
- Encrypted at rest (e.g. in the database)
- Encrypted in transit (between client and server)

At rest   In transit   In use
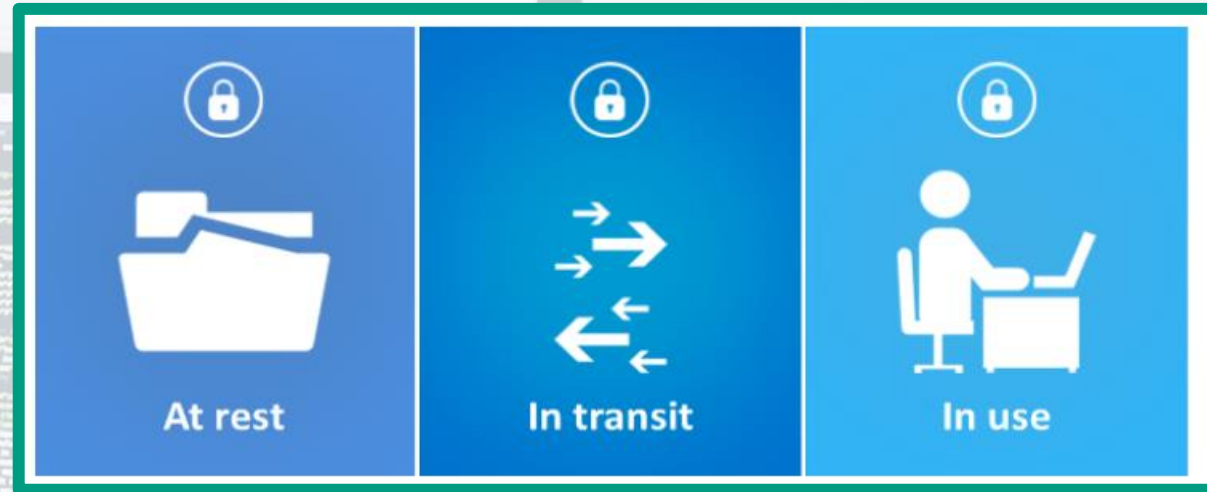
Integrity - *The degree to which a system, product or component prevents unauthorized access and alteration of computer programs or data.*

Encryption

Is the process of taking data and changing it following a set rules into a different value so that the data is more secure.

A basic example would be a Caesar cipher where characters are shifted by a key amount.

For example if Bob and Alice where communicating, and Bob told Alice he would send her a letter using Ceasar cipher +2 then each character of the letter would be needed to be shifted by -2

So if Karin intercepts the letter, she would not be able to understand what was said.

By this logic, can you translate what Bob said to Alice below.

dcvocp

Security: Sometimes goes wrong

VDL Nedcar will remain closed for almost a week after hack | Financial

jenniferruffalo · 3 weeks ago

On Thursday and Friday, VDL Nedcar was shut down as a result of a large-scale computer hack at parent company VDL Groep. Provided the digital systems could be started up in time, Tuesday and Wednesday next week could have acted as catch-up days. But they now hope to be able to resume on Thursday.

Activity

- For the information systems below formulate the requirements:

- Whether internet access is permitted
- Whether access is only permitted after logging in
- If so, whether MFA is also required
- Whether data should be encrypted at rest
- Whether data in transit should be encrypted

- Brightspace Saxion
- Bison Saxion
- Website Saxion
- FC Twente website

Portability

Adaptability - *The degree to which a product or system can be effectively and efficiently adapted to different or evolving hardware, software or other operational or user environments.*

Important questions:

- Does the application need to be hardware independent?
- So, for example, can it run on updated hardware?

This requirement actually applies all the time.

Working on the case

Case

- On Brightspace read the business case about the Municipality of Enschede. See the assignments document.

- After lesson 1.1:
  - Do the assignments of week 0. See the assignments document and the template report.

- After lesson 1.2:
  - Do the assignments of week 1. See the assignments document and the template report.

Any questions?