Resilient Computing

Oleh:

Idris Winarno

Agenda

- Introduction
- Resilient Server
- CARS: Cyber Attack-Resilient Server
- RaaS: Resilient as a Service
- Resilient Software-Defined Networking

Terminator (1991)

Have you ever watched this movie?
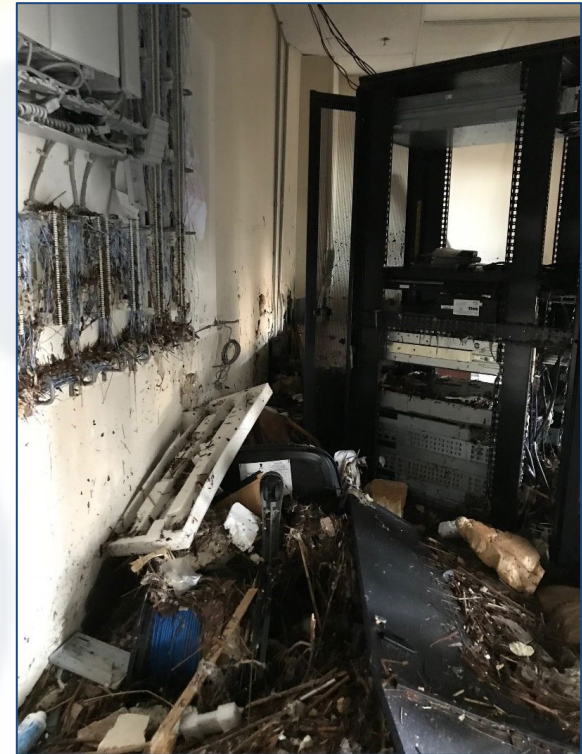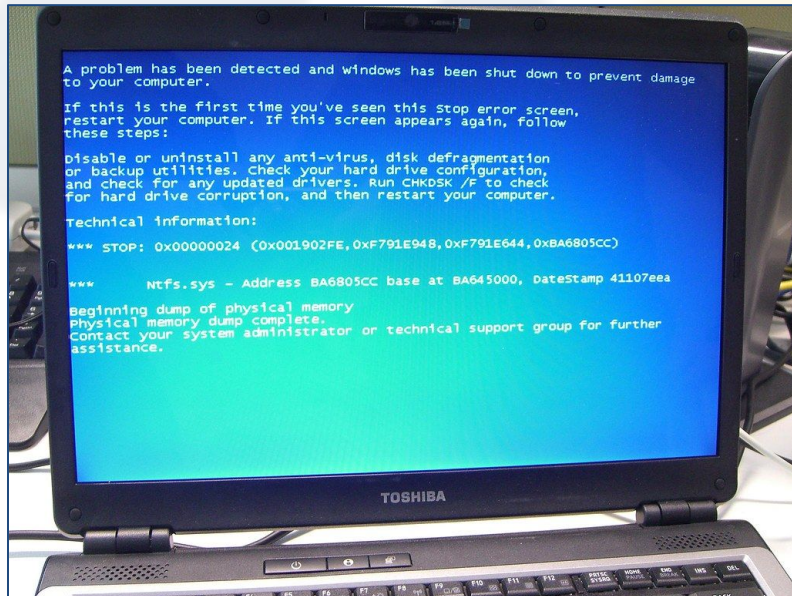
Transcendence (2014)

AND THIS MOVIE....?

Introduction

Logical and physical failure

Introduction: resilience

- "resilience" → Latin verb resilire (re-salire: to jump back)
- ability of a body to recover its normal size and shape after being pushed or pulled out of shape
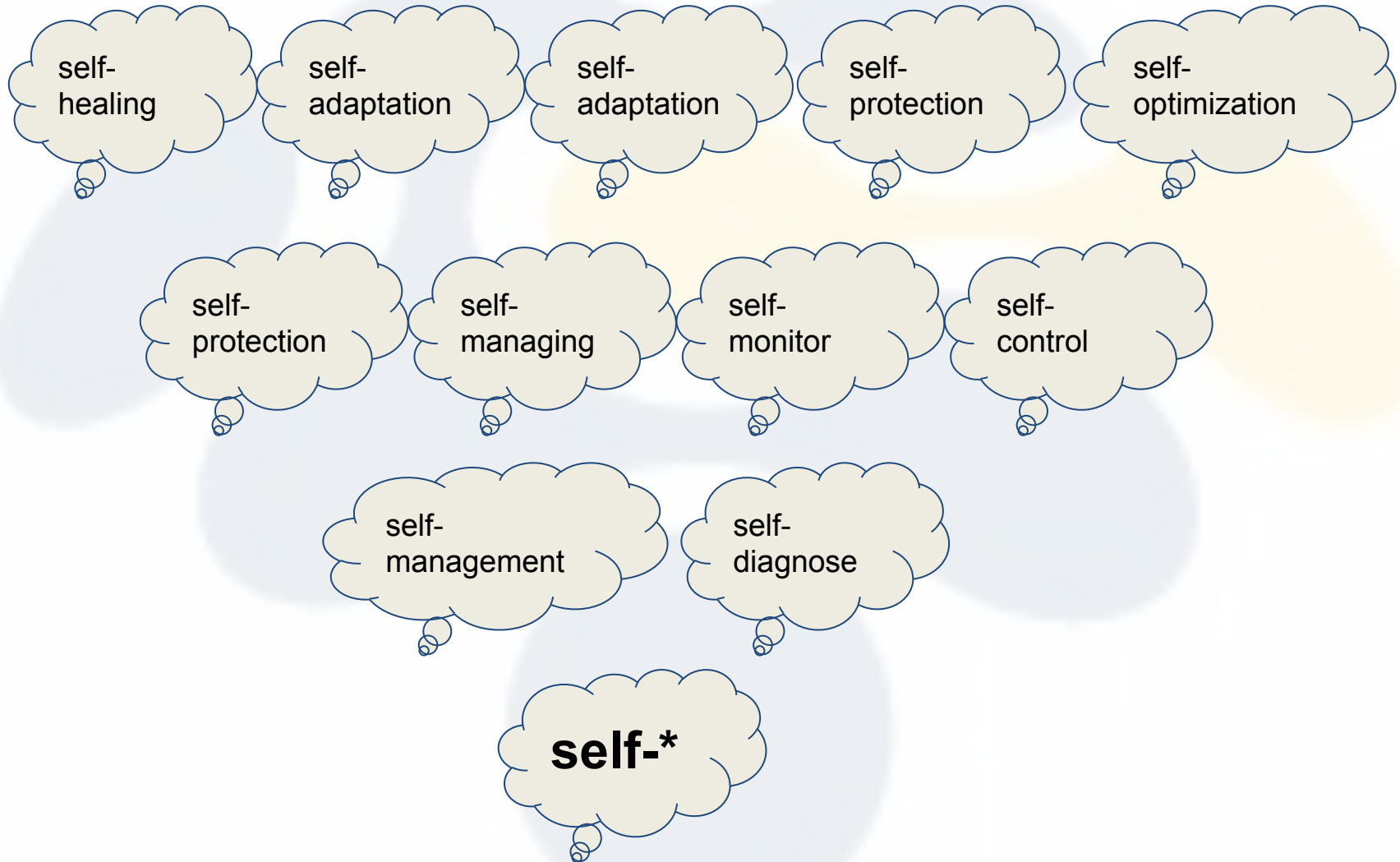- **Ability to recover to normality after a disturbance**.

RESILIENT

Introduction: keywords

Keywords:

- Diversity

- Auto-recovery

- Human-free

Introduction: self-*

self-healing

self-adaptation

self-adaptation

self-protection

self-optimization

self-protection

self-managing

self-monitor

self-control

self-management

self-diagnose

self-*

Self-Healing[*]

…...is inspired from the biological healing process for human and animals, where the body heals itself by repairing the affected tissue or bone, the process of healing is carried out internally from inside the body, the cells will gather in the place that has been affected (ex. Tissue insured or bold vessel cut) and the heal process retain the affected place to its original health status.
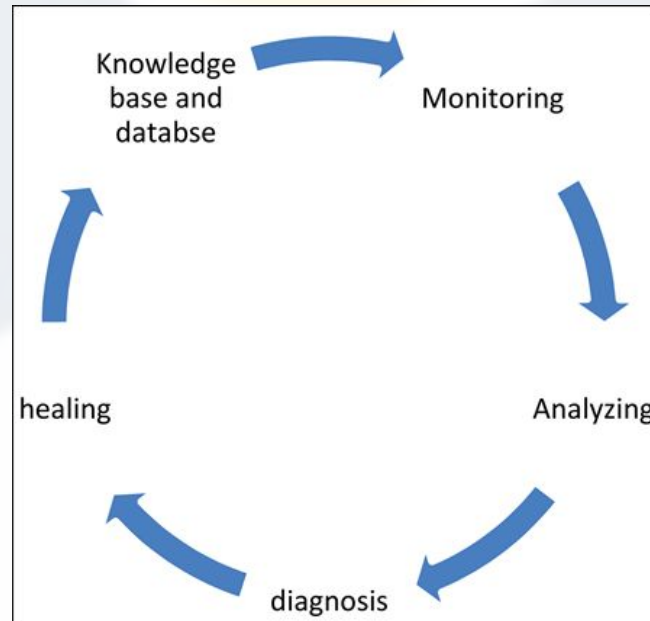
SR^3

- Self-Recognition
- Self-Repairing
- Self-Reconfiguration
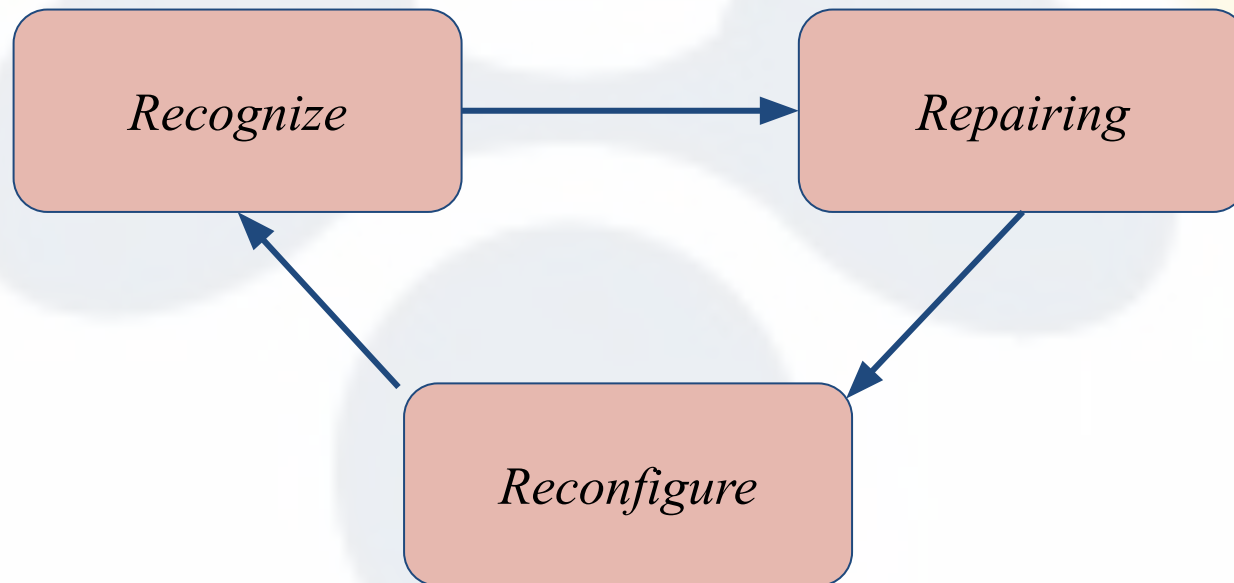
Resilient Computing System Area

- Fault tolerant computing
- Hardware fault tolerance
- Design fault tolerance
- Reliable communication
- Resilient real-time systems
- Robust distributed programs
- Software Safety
- Software reliability prediction

(1) Resilient Server
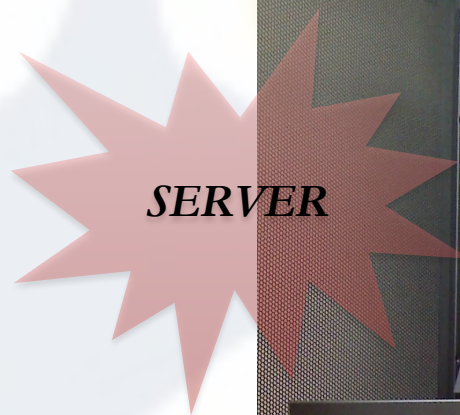
SERVER

Resilient Server: Definition

- Able to recover from unhealthy to healthy state
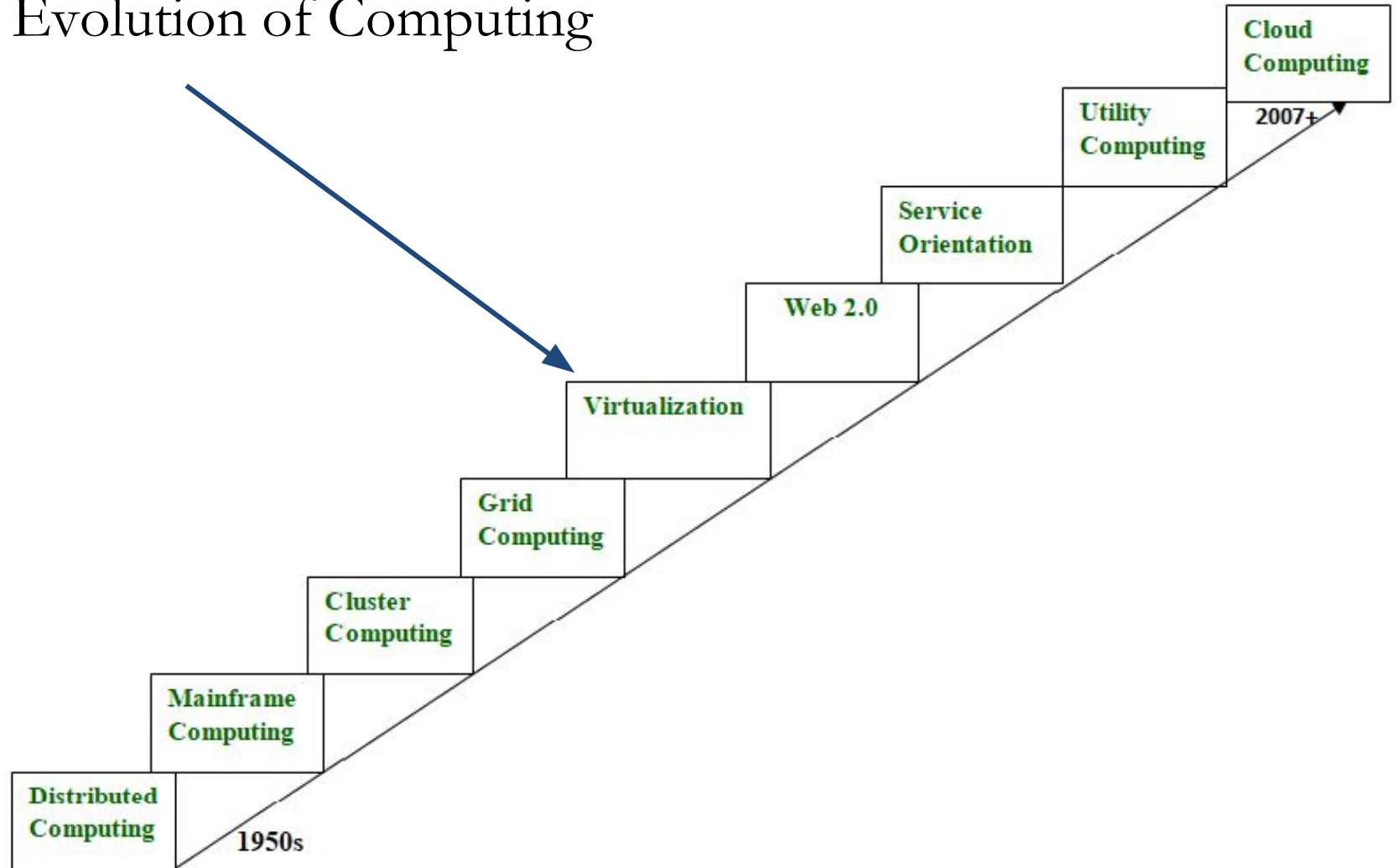- Self-observation
- Automatic/human free

machine
human

Resilient

Observe

Decision → Response
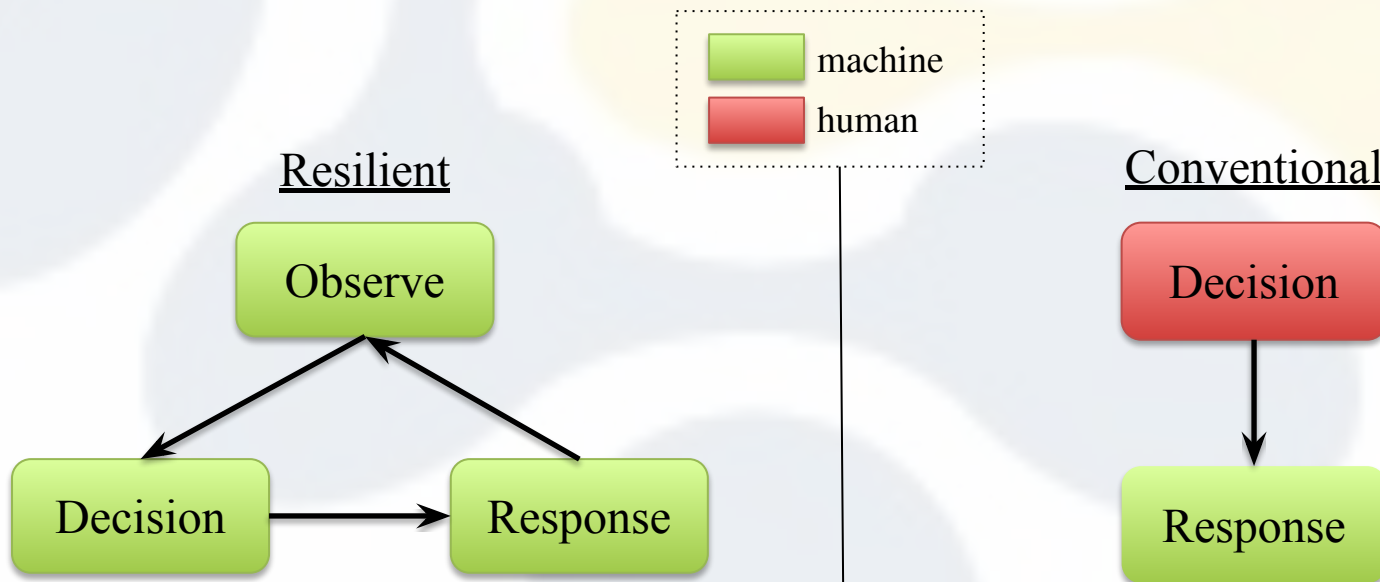
- Automatically recover from failure.
- Observing its own behavior.
- No human intervention.

Conventional

Decision

Response

- Manually recover from failure.
- No observation.
- Require human interaction.

Resilient Server: Background

Evolution of Computing

Cloud Computing

Utility Computing

2007+

Service Orientation

Web 2.0

Virtualization

Grid Computing

Cluster Computing

Mainframe Computing

Distributed Computing

1950s

https://www.geeksforgeeks.org/evolution-of-cloud-computing/

Resilient Server: Background

Hypervisor (VM Engine)

Type-1 hypervisor   Type-2 hypervisor
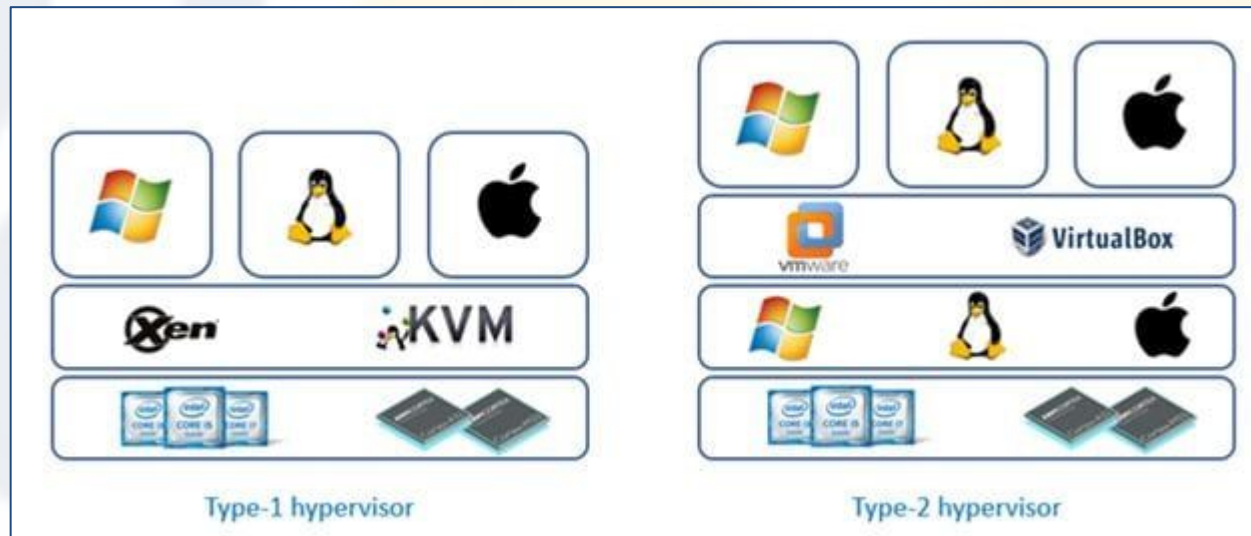
image source: infosecinstitute.com

Resilient Server: VMI

- Virtual Machine Introspection

  - In-VMI

  - Out-VMI

Type-1 hypervisor

*image source: infosecinstitute.com
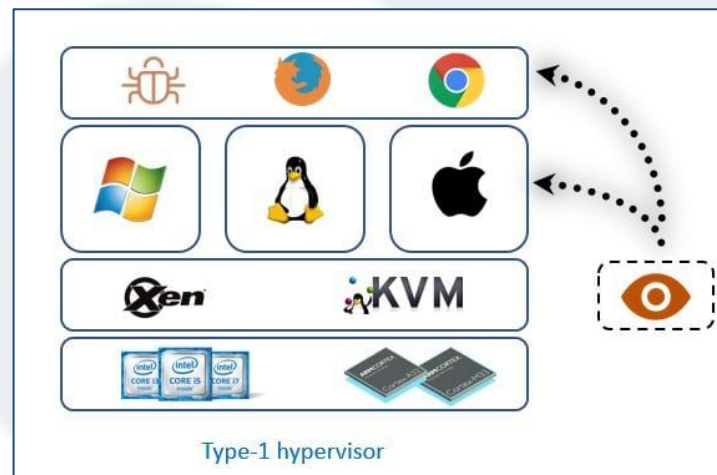
Resilient Server: Diversity
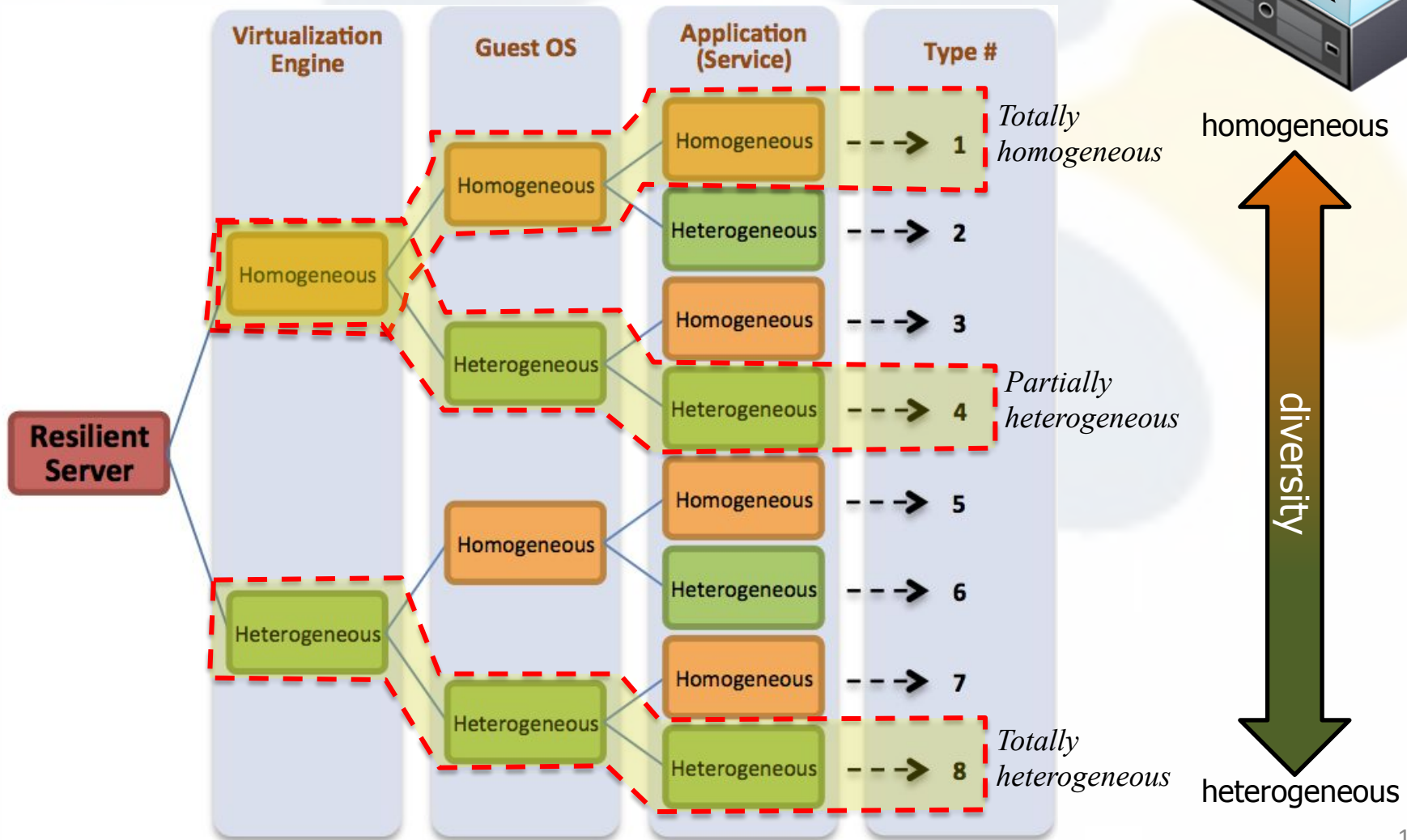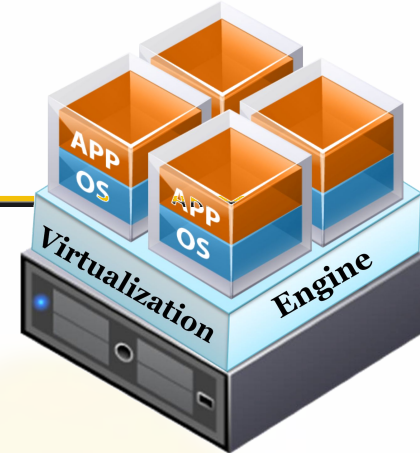
Resilient Server: Type #1
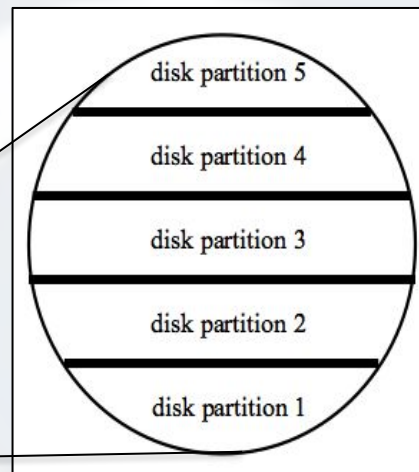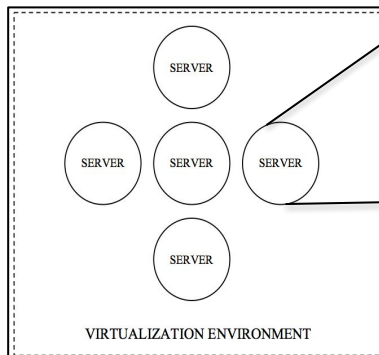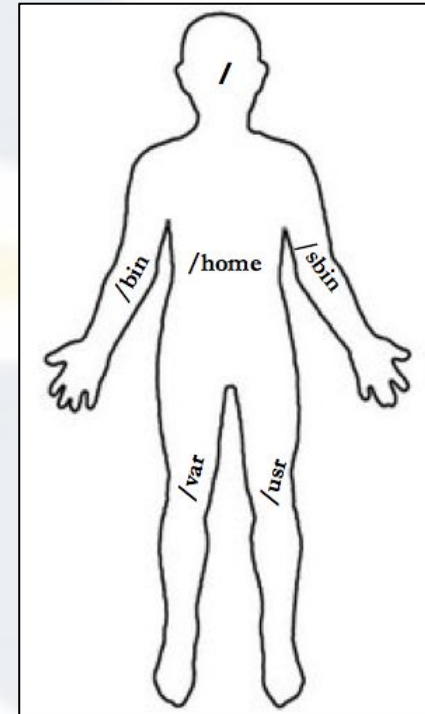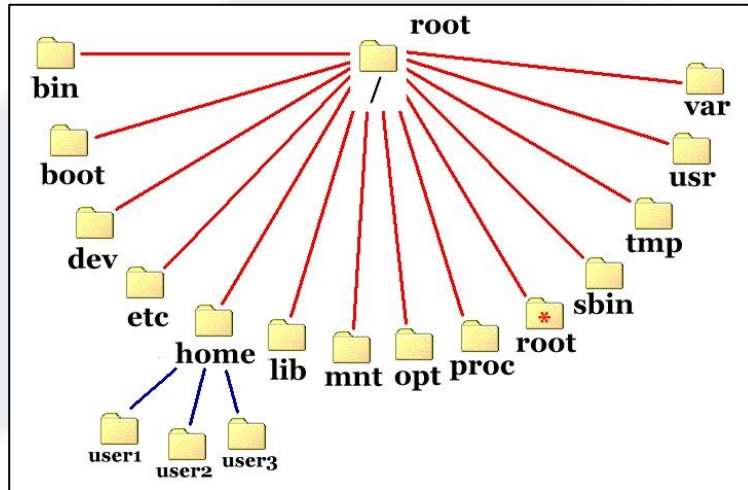
Resilient Server: Type #1
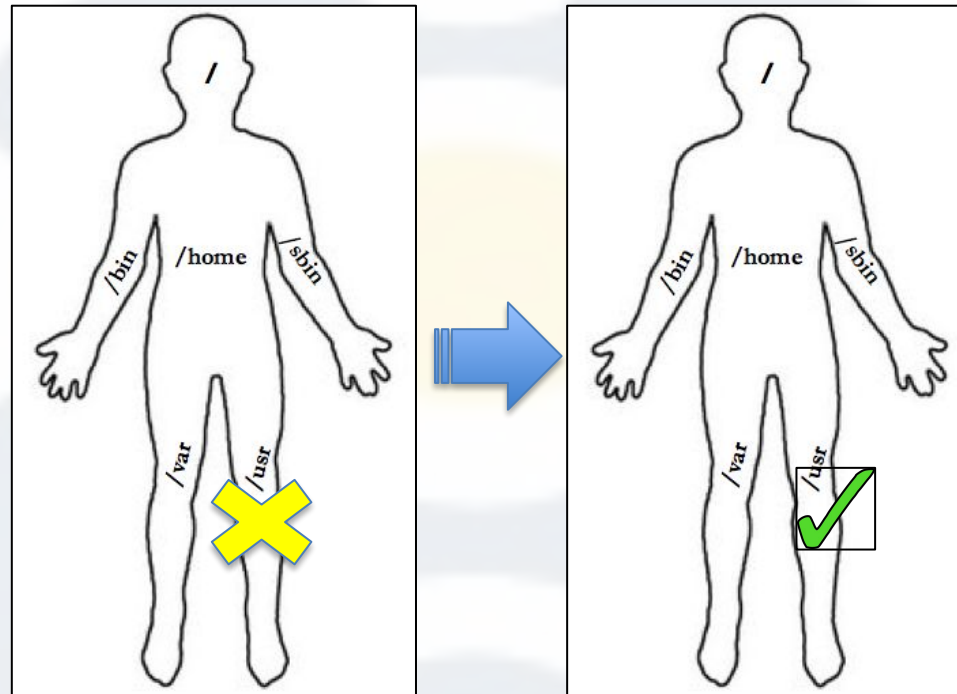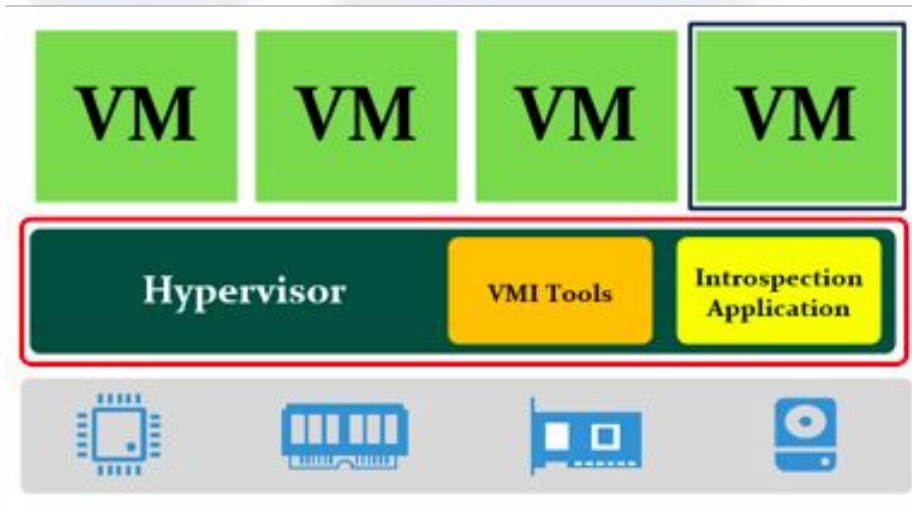

*Self-Repair Network
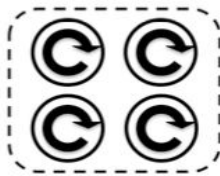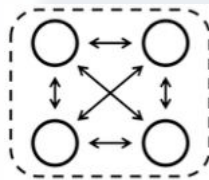
Self-repair   Mutual-repair   Mixed-repair   Switch-repair
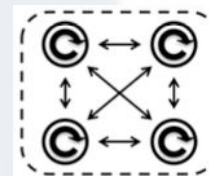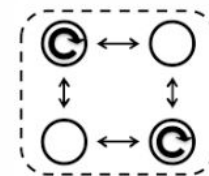
Resilient Server: out-VMI

System Design
(Hang detection: partial/full)

Utomo et al., 2020

Resilient Server: out-VMI

System Design
(Hang detection: partial/full)
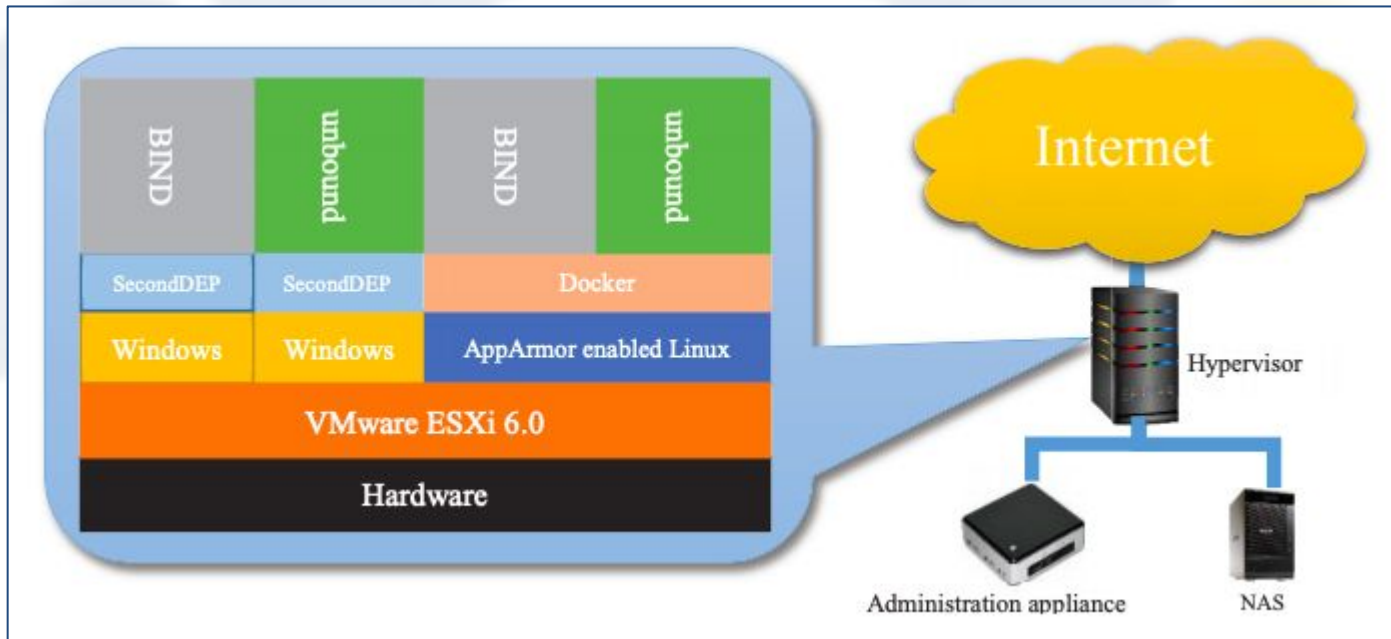
Utomo et al., 2020

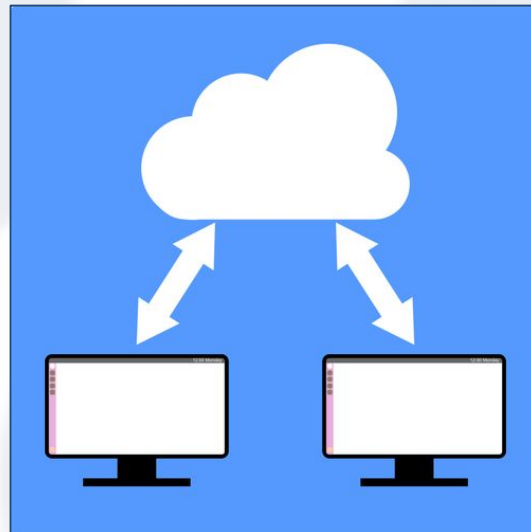# Resilient Server: out-VMI
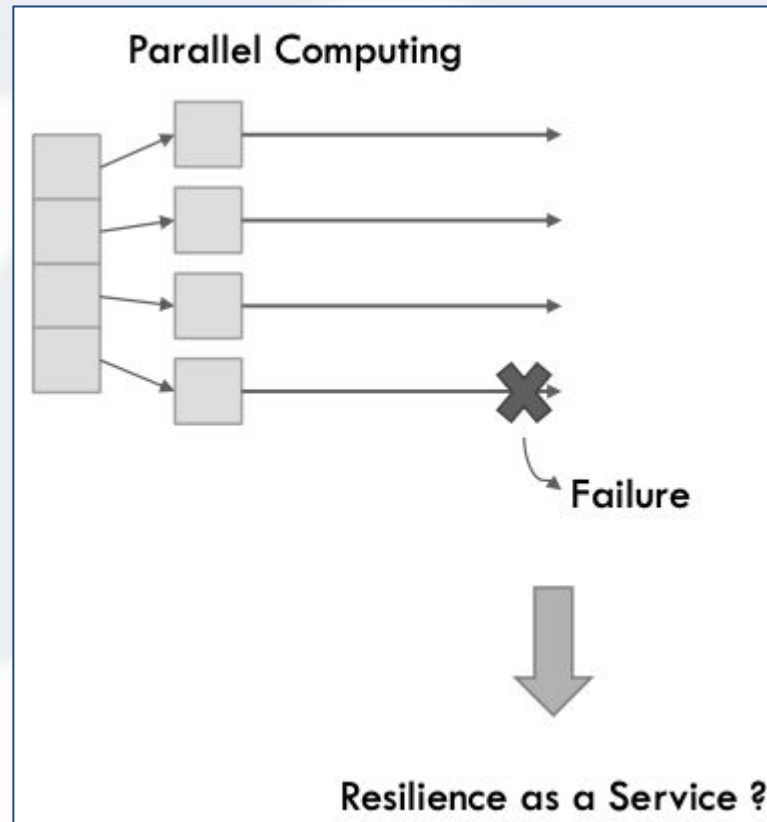
(2) Cyber Attack-Resilient Server

CARS: System Design

CASR: Implementation

(3) Resilient as a Service

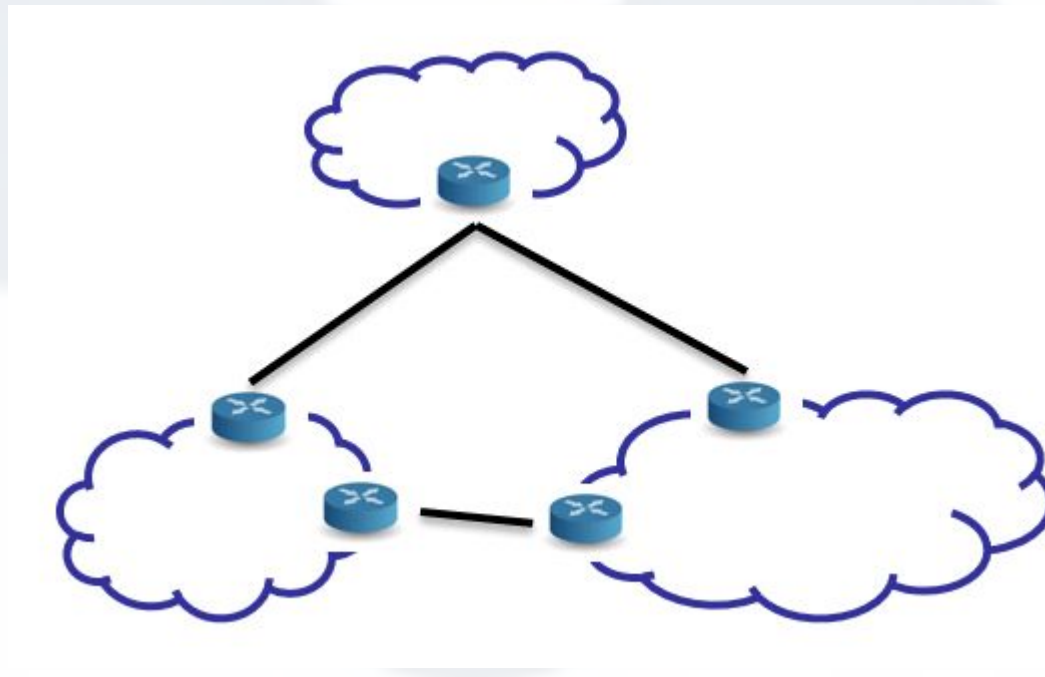# RaaS: Background

Parallel Computing

Failure

Resilience as a Service ?

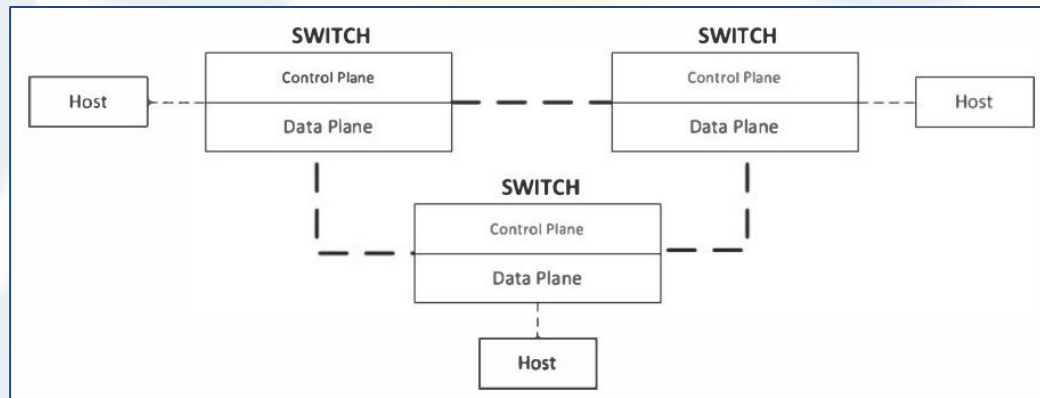# RaaS: System Design

Revina et al., 2020
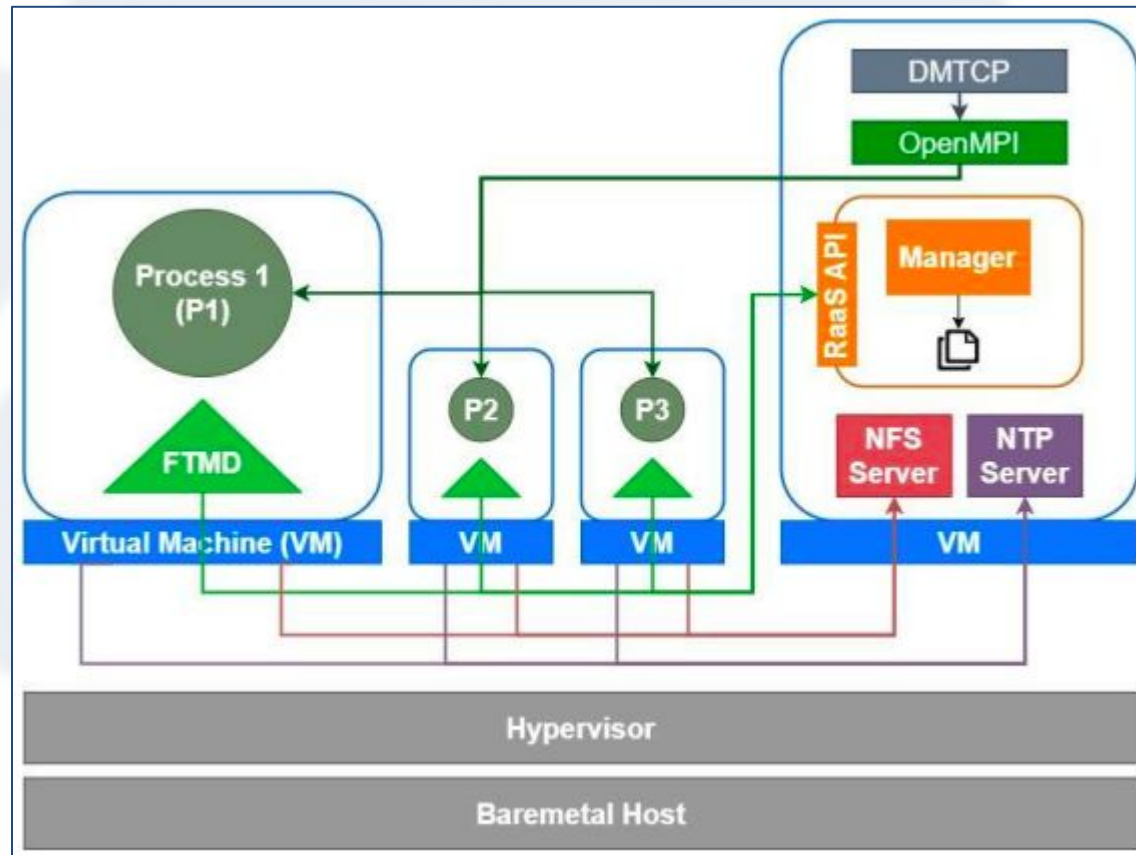
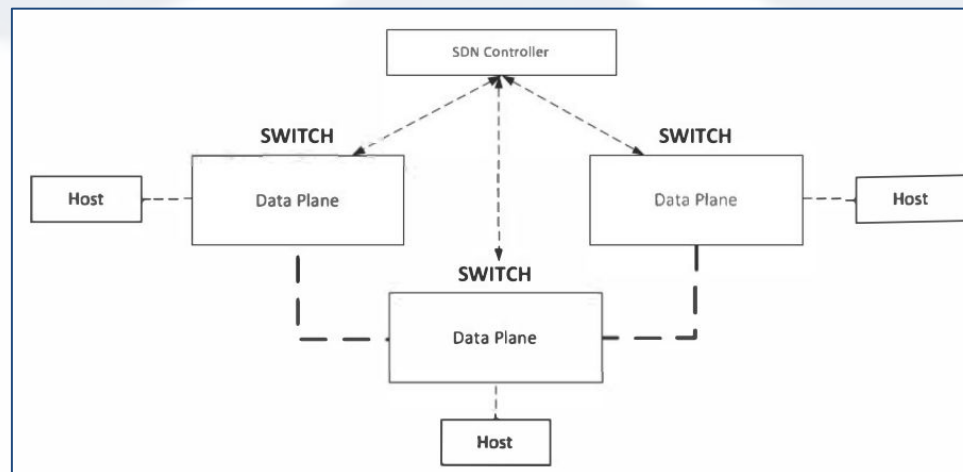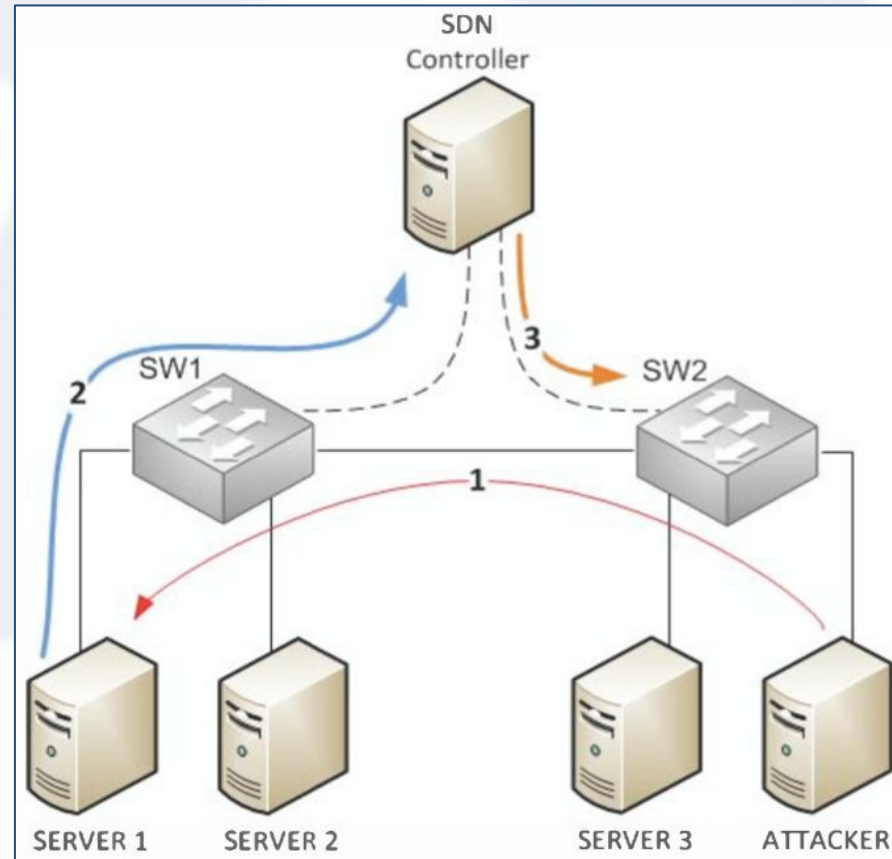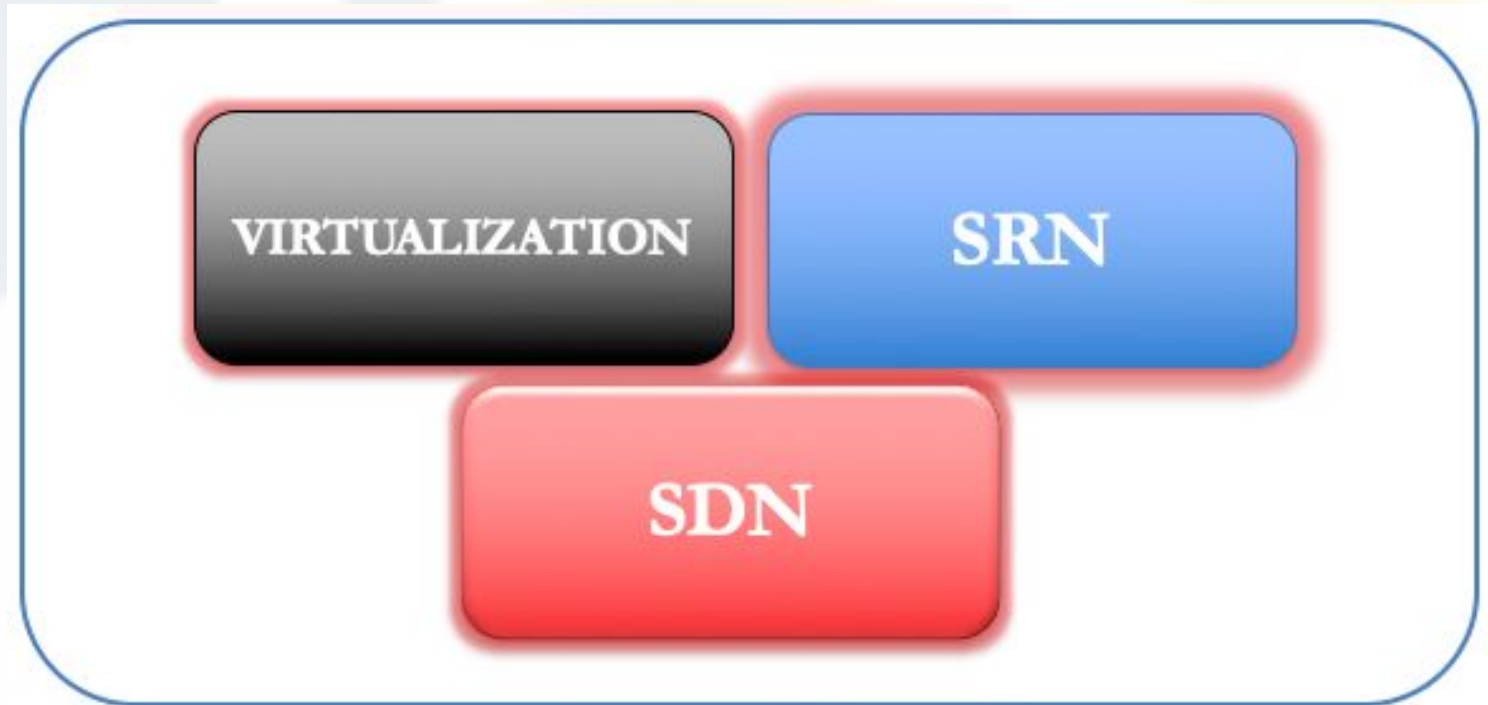# (4) Resilient Software Defined-Networking

Resilient SDN

- Traditional network

- SDN

Resilient SDN

Resilient SDN+

Q&A

https://orcid.org/0000-0001-9436-6836

Thanks