

Program Fresh Graduate Academy Digital Talent Scholarship 2019 | Machine Learning

Konsep Teknologi Cloud & Virtualisasi

Nama pembicara dengan gelar





Bagian 1

Konsep Teknologi Cloud Computing

Komponen Cloud Computing

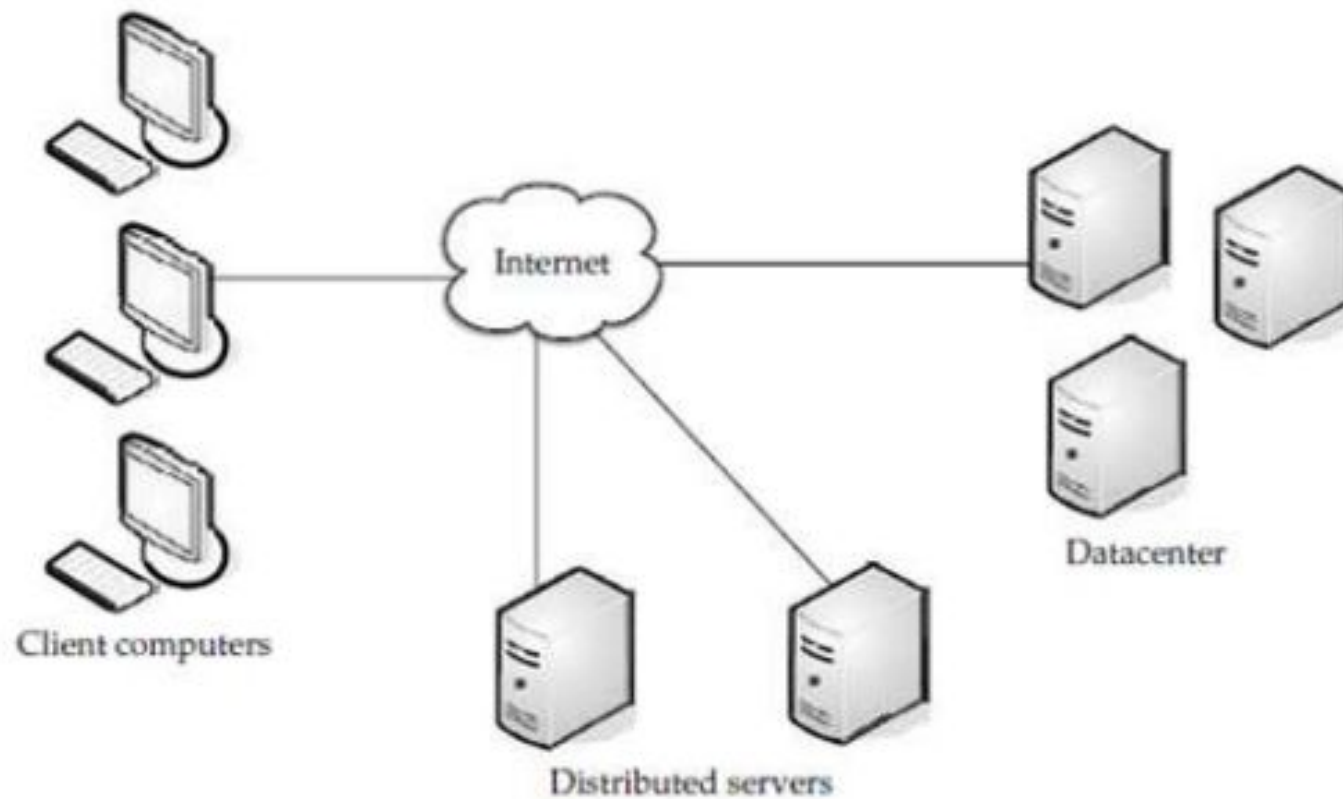
- Komponen dasar:
 - Clients : LAN, Laptop , PC, Mobile phone, PDA, dll
- Data Center
 - Hardware: Kumpulan server di sebuah gedung
 - Software: Virtualizing server
- Distributed Server
 - Server-server yg tersebar di beberapa lokasi

Komponen Cloud Computing

Komponen lain:

- Cloud Application “ Software
- Cloud Services : Produk layanan dan slousi
- Cloud Platform : Hardware & Software
- Cloud Storage
- Cloud Infrastructure

Komponen Cloud Computing



Komponen Cloud Computing

- Cloud Client ; adalah seperangkat komputer ataupun software yang didisain secara khusus untuk penggunaan layanan berbasis cloud computing
 - Mobile ; Windows mobile, Symbian, dan lain-lain
 - Thin Client ; Windows terminal service, CherryPal, dll
 - Thick Client ; Internet explorer, FireFox, dll

Komponen Cloud Computing

- Cloud Services ; adalah produk layanan dan solusi yang dipakai dan disampaikan secara real time melalui media internet. Contoh yang paling populer adalah :
 - Identitas ; OpenID, Oauth, dan lain-lain
 - Integration ; Amazon Simple Queue Service, dll
 - Payment ; Paypal, Google Chekout, dll • Mapping ; Google Maps, Yahoo ! Maps,

Komponen Cloud Computing

- Cloud Application ; Memanfaatkan cloud computing dalam hal arsitektur software, sehingga user tidak perlu meng-install dan menjalankan aplikasi pada komputer
 - Per-to-peer ; BitTorrent, SETI, dan lain-lain
 - Web Application : Facebook
 - SaaS : Google Apps, Salesforce.com, dan lain-lain

Komponen Cloud Computing

- Cloud Platform ; merupakan layanan berupa platform komputasi yang berisi software dan hardware infrastruktur, biasanya memiliki aplikasi bisnis tertentu dan menggunakan layanan PaaS sebagai infrastruktur aplikasi bisnisnya, contoh:
 - Web Application Framework ; Phyton Django, Rubyan Rails, .Net
 - Web Hosting
 - Proprietary – Force.com

Komponen Cloud Computing

- Cloud Storage ; Melibatkan proses penyampaian penyimpanan data sebagai sebuah layanan, misalnya
 - Database ; Google Big Table, Amazon SimpleDB
 - Network Attached Storage ; Nirvanix CloudNAS, Mobile Me iDisk.

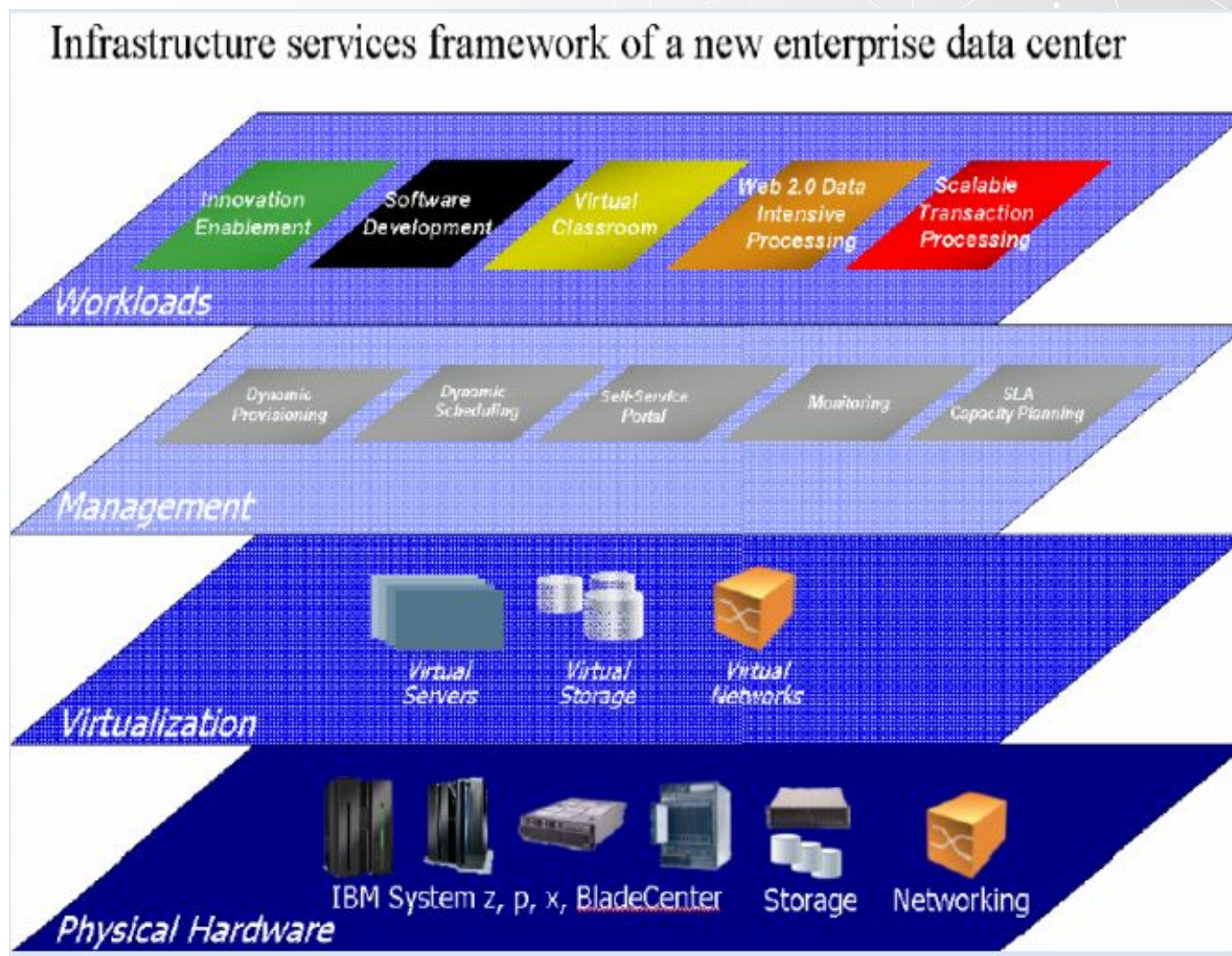
Komponen Cloud Computing

- Cloud Infrastructure ; merupakan penyampaian infrastruktur kemampuan sebuah layanan, contohnya :
 - Grid Computing ; Sun Grid
 - Full Virtualization ; GoGrid , Skytap
 - Compute ; Amazon Elastic Compute Cloud

Fitur-fitur Cloud Computing

- Self-healing
- Multi-tenancy
- Virtualized
- Linearly Scalable
- Resource Monitor and measure
- Resource registration and discovery

Arsitektur Cloud Computing



Apa arti Cloud Computing bagi Service Provider ?

- Cepat menyediakan layanan
- Mengurangi skala server
- Meningkatkan tingkat utilisasi resources
- Memperbaiki efisiensi pengelolaan
- Biaya pemeliharaan lebih rendah
- Lokasi infrastruktur di area biaya gedung dan listrik yang rendah

Apa arti Cloud Computing bagi Service Provider ?

- Memberikan 'business continuity service'
- Meningkatkan efisiensi manajemen operasional
- Meningkatkan 'service level'
- Arsitektur yang kompleks
- Mengubah model bisnis dan tingkat kepercayaan

Apa arti Cloud Computing bagi User ?

- Mengurangi beban kerja klien atau beban kerja klien menjadi lebih rendah
- Total Cost Ownership (TCO) lebih rendah
- Pemisahan tugas pemeliharaan infrastruktur dari domain-spesifik pengembangan aplikasi
- Pemisahan kode aplikasi dari sumber-daya fisik
- Tidak perlu membeli asset untuk ‘pemakaian satu kali’ atau pekerjaan komputing yang tidak sering penggunaanya

Apa arti Cloud Computing bagi User ?

- Tidak perlu membeli asset untuk ‘pemakaian satu kali’ atau pekerjaan komputing yang tidak sering penggunaanya
- Memperbesar ‘resources on-demand’
- Membuat aplikasi memiliki ‘high availability’
- Cepat men-deploy aplikasi
- • Membayar apa yang digunakan (Pay per use)

Keuntungan Teknologi Cloud Computing Bagi User

- **Flexibility:**

- User dapat menentukan berapa space storage yang akan digunakan, berapa banyak processing power yang dibutuhkan, dan lain-lain

- **Scalability:**

- User dapat bergerak dari yang kecil ke yang besar dengan cepat

Keuntungan Teknologi Cloud Computing Bagi User

- **Capital Investment :**

- User tidak perlu investasi layanan IT

- **Portability :**

- User dapat mengakses thin clientnya dari mana saja

Kendala cloud computing

- Continuous high availability
- Konsistensi (Consistency)
- Interoperability dan Standartization
- Skalabilitas untuk semua komponen
- Data secrecy

Kendala cloud computing

- Permasalahan legal dan politik dari penyimpanan data dan translasi menyeberangi region
- Issu performansi
- Kesulitan kastemisasi
- Hambatan organisasi

Kendala Cloud Computing

- **Service level**

- Cloud provider mungkin tidak akan konsisten dengan performance dari application atau transaksi.
- Mengharuskan anda untuk memahami service level mengenai transaction response time, data protection dan kecepatan data recovery.

Kendala Cloud Computing

- **Privacy**

- Karena orang lain / perusahaan lain juga melakukan hosting kemungkinan data anda akan keluar atau di baca oleh pemerintah U.S. dapat terjadi tanpa sepengetahuan anda atau approve dari anda.

- **Compliance**

- Cloud service provider diharapkan dapat menyamakan level compliance untuk penyimpanan data didalam cloud

Kendala Cloud Computing

- **Data ownership**

- Apakah data anda masih menjadi milik anda begitu data tersebut tersimpan didalam cloud?
- Mungkin pertanyaan ini sedikit aneh, namun anda perlu mengetahui seperti hal nya yang terjadi pada Facebook yang mencoba untuk merubah *terms of use aggrement* nya yang mempertanyakan hal ini.

Kendala Cloud Computing

- **Data Mobility**

- Apakah anda dapat melakukan share data diantara cloud service?
- Jika anda terminate cloud relationship bagaimana anda mendapatkan data anda kembali?
- Format apa yang akan digunakan ?
- Dapatkah anda memastikan kopi dari datanya telah terhapus ?

Issu-issu Pada cloud computing

- Privileged user access.
- Regulatory compliance.
- Data location.
- Data segregation.
- Recovery.
- Investigative support.
- Long-term viability.

Pengguna dan Penyelenggara Layanan Cloud Computing

- Contoh 10 Perusahaan pengguna Cloud
- Contoh Penyedia Layanan SaaS
- Contoh Penyedia Layanan PaaS
- Contoh Penyedia Layanan IaaS

10 Contoh Perusahaan Pengguna Layanan clouds

No	Perusahaan	Provider
1	<u>The NY Times</u>	Amazon EC2
2	<u>Nasdaq</u>	Amazon S3
3	<u>Major League Baseb</u>	Joyent
4	<u>ESPN</u>	Rightscale using Amazon EC2
5	<u>Hasbro</u>	Amazon EC2
6	<u>British Telecom</u>	3Tera
7	<u>Taylor Woodrow</u>	Google Apps
8	<u>CSS</u>	Amazon EC2
9	<u>Activision</u>	Amazon EC2
10	<u>Business Objects (A SAP Company)</u>	Rightscale using Amazon EC2

Contoh Penyedia Layanan SAAS (Software as a Service)

BILLING

- Aria Systems
- eVapt
- OpSource
- Redi2
- Zuora

FINANCIAL

- Concur
- Xero
- Workday
- Beam4d

LEGAL

- DirectLaw
- Advologix
- Fios
- Sertifi

SALES

- Xactly
- LucidEra
- StreetSmarts
- Success Metrics

PRODUCTIVITY

- Zoho
- IBM Lotus Live
- **Google Apps**
- HyperOffice
- **Microsoft Live**
- ClusterSeven

HUMAN RESOURCE

- Taleo
- Workday
- ICIMSe

CONTENT MANAGEMENT

- Clickability
- SpringCM
- CrownPoint

CRM

- NetSuite
- Salesforce
- Parature
- Responsys
- Rightnow
- Sales.com
- LiveOps
- MSDynamics
- Oracle On Demand

DOCUMENT MANAGEMENT

- NetDocuments
- Questys
- DocLanding
- Aconex
- Xythos
- Knowledge TreeLive
- SpringCM

COLLABO RATION

- Box.net
- DropBox

SOCIAL NETWORKS

- Ning
- Zembly
- Amitive

Contoh Penyedia Layanan PAAS (Platform as a Service)

GENERAL PURPOSE

- Force.com
- Etelos
- LongJump
- AppJet
- Rollbase
- Bungee Labs Connect
- Google App Engine
- Engine Yard
- Caspio
- Qrimp
- MS Azure Services Platform
- Mosso Cloud Sites

BUSINESS INTELLIGENT

- Aster DB
- Quantivo
- Cloud9 Analytics
- Blink Logic
- K2 Analytics
- Oco
- Panorama
- PivotLink
- Clario Analytics
- CloudLight
- Neuron
- Infobright
- Vertica

INTEGRATION

- Amazon SQS
- MuleSource Mule OnDEmand
- Boomi
- SnapLogic
- Opsource Connect
- Cast Iron
- Microsoft BizTalk Service
- Gnip
- Snaplogic SaaS Solution Packs
- Appian Anywhere
- HubSpan
- Informatica On-Demand

DEVELOPMENT & TESTING

- Keynote Systems
- Mercury
- SOASTA
- SkyTap
- Aptana
- LoadStorm
- Collabnet
- Dynamsoft

DATABASE

- Google Big Table
- Amazon SimpleDB
- FathomDB
- Microsoft SDS

Contoh Penyedia Layanan PAAS (Platform as a Service) - lanjutan

DATA

- 10Gen MongoDB
- Oracle Coherence
- Gemstone
- Gemfire
- Apache CouchDb
- Apache Hbase
- Hypertable
- TerraCotta
- Tokyo Cabinet
- Cassandra
- Memcached
- Infinispan

CLOUD MANAGEMENT

- Jtera App Logic
- OpenNebula
- Open.ControlTier
- Enomaly Enomalism
- Altor Networks
- Vmware vSphere
- OnPath Tech
- CohesiveFT VPN Cubed
- Hyperic
- Eucalyptus
- Reductive Lbs Puppet
- OpenQRM
- Appistry
- VMWare VCloudExpress

COMPUTE

- Globus Toolkit
- Xeround
- Beowulf
- Sun Grid Engine
- Hadoop
- OpenCloud
- Gigaspaces
- DataSynapse

FILE STORAGE

- EMC Atmos
- ParaScale
- Zmamba
- CTERAd

APPLIANCE

- PingIdentity
- Sysplified
- rPath
- Vordell

Contoh Penyedia Layanan IAAS (Infrastructure as a Service)

STORAGE

- Amazon S3
- Zetta
- CTERA Portal
- Mosso Cloud Files
- Nirvanix

CLOUD BROKERS

- RightScale
- enStratus
- Kaavo
- Elastra
- CloudKick
- CloudSwitch

COMPUTE

- Amazon EC2
- Serve Path GoGrid
- Elastra
- Mosso Cloud Servers
- Joyent Accelerations
- AppNexus
- Flexiscale
- Elastichosts
- Hosting.com CloudNine
- Terremark
- GridLayer
- ITRICITY
- LayeredTech

SERVICE MANAGEMENT

- Scale
- CohesiveFT
- Ylastic
- Dynect
- CloudFoundry
- NewRelic
- Cloud42

BACKUP & RECOVERY

- JungleDisk
- Mosy
- Zmanda Cloud Backup
- OpenRSM
- Syncplicity



Bagian 2

Virtualization

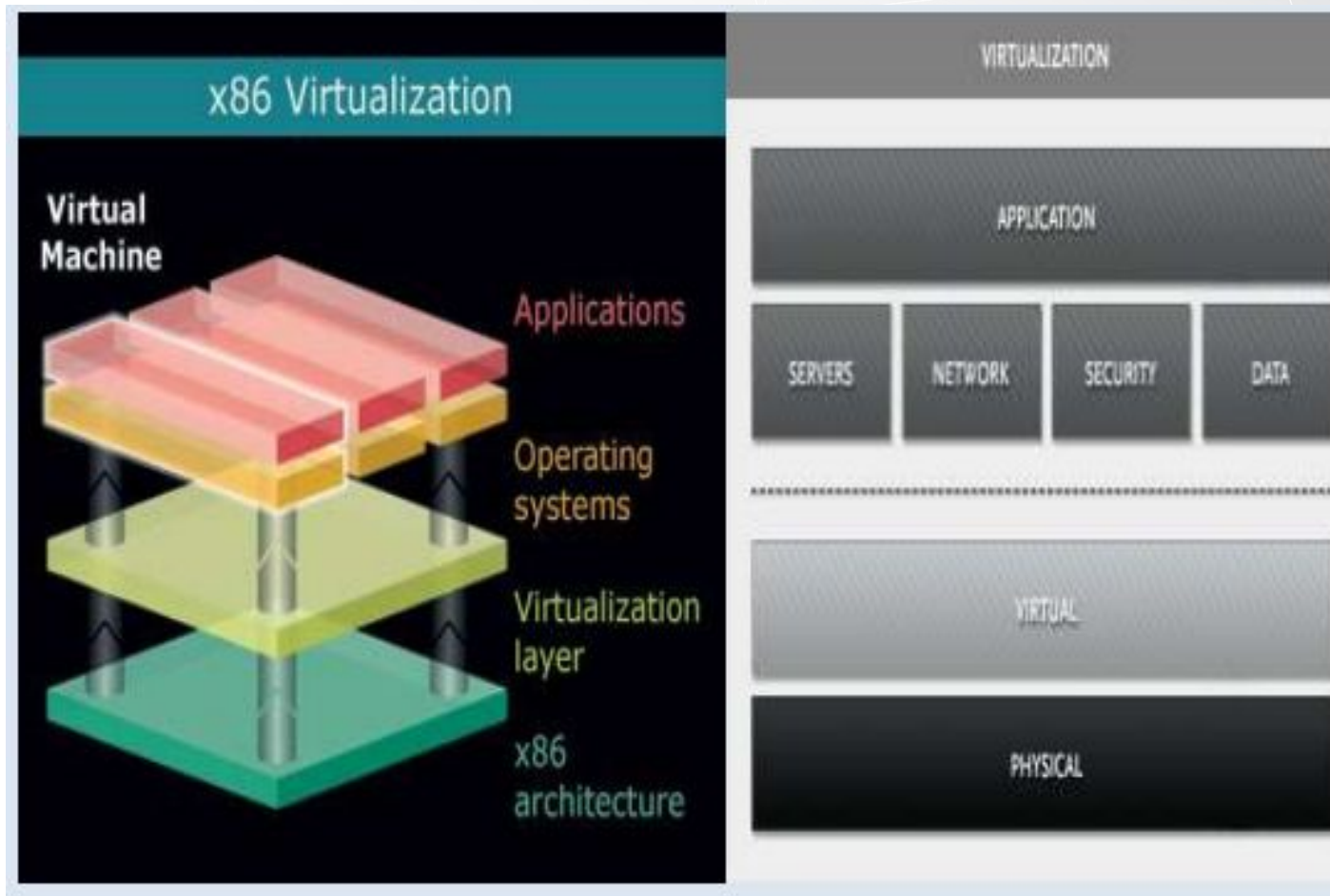
Virtualisasi

- Virtualisasi adalah istilah luas pemisahan sumber daya komputer (jaringan, storage dan server)
- Virtualisasi menyembunyikan karakteristik fisik sumber daya komputasi ke pengguna (aplikasi atau end-user)

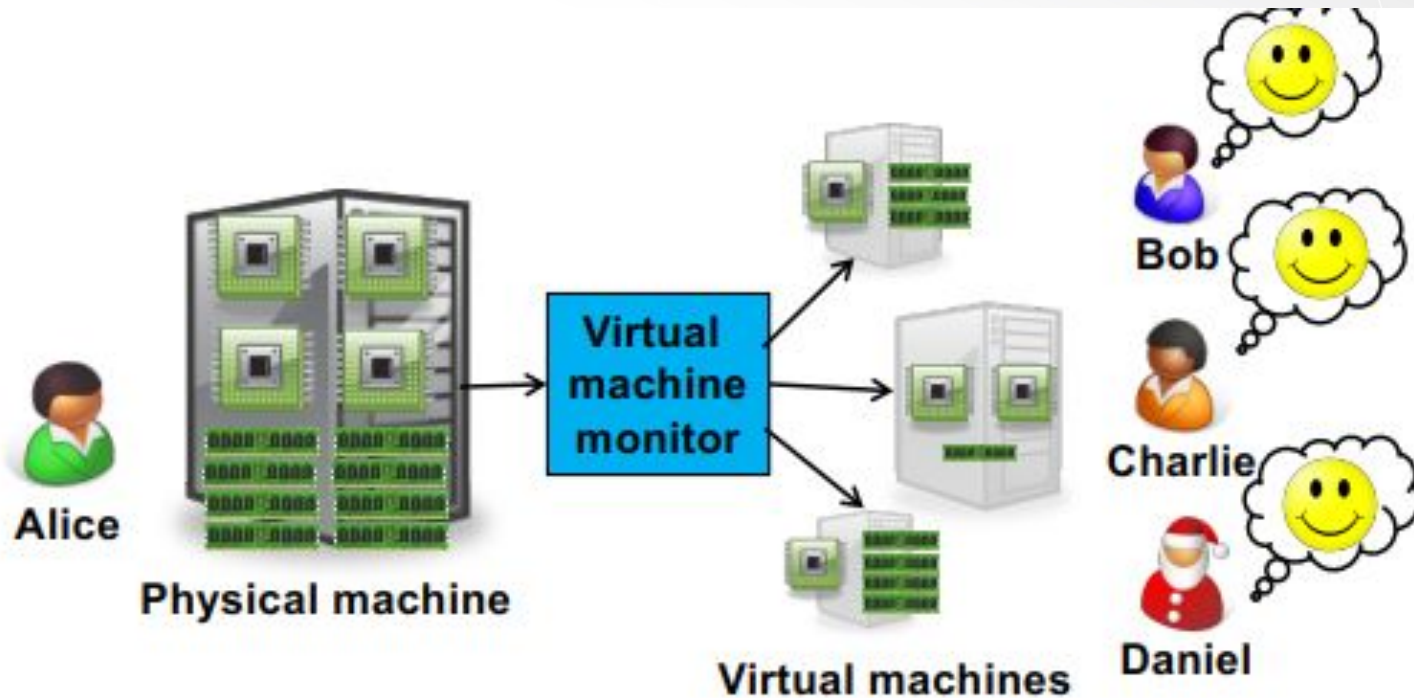
Virtualisasi

- Sebuah physical resources (sebuah server/aplikasi /storage) dapat terlihat seperti beberapa resources virtual dan sebaliknya.
- Teknologi virtual : Virtualisasi storage, virtualisasi komputasi dan virtualisasi network

Virtualisasi



Virtualization is key enabler



The idea of Virtualization: from 1960's

- IBM VM/370 – A VMM for IBM mainframe
 - Multiple OS environments on expensive hardware
 - Desirable when few machine around
- Popular research idea in 1960s and 1970s
 - Entire conferences on virtual machine monitors
 - Hardware/VMM/OS designed together
 - Allowed multiple users to share a batch oriented system

The idea of Virtualization: from 1960's

- Interest died out in the 1980s and 1990s
 - Hardware got more cheaper
 - Operating systems got more powerful (e.g. multi-user)

A Return to Virtual Machines

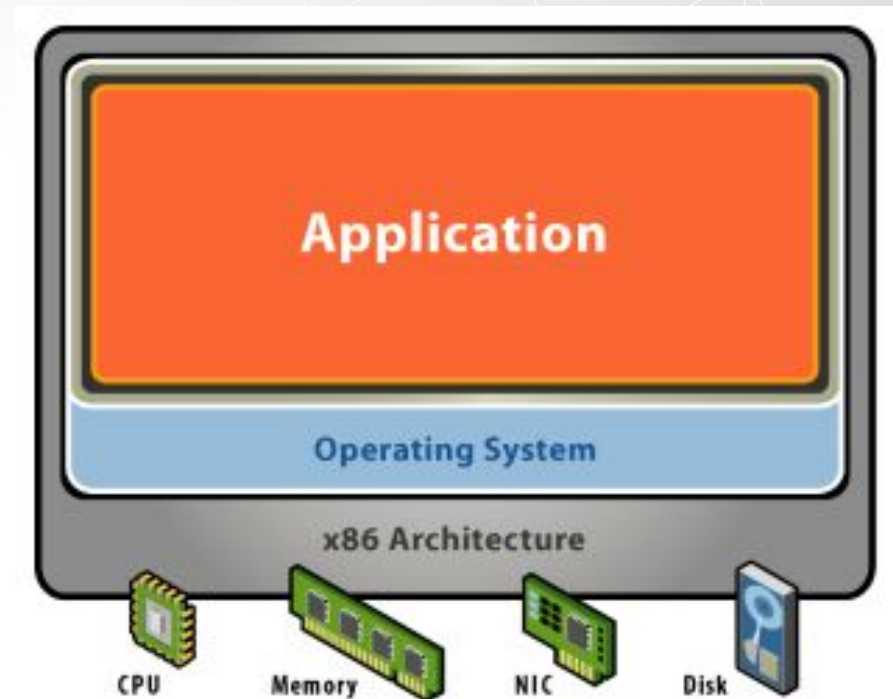
- Disco: Stanford research project (SOSP '97)
 - Run commodity OSes on scalable multiprocessors
 - Focus on high-end: NUMA, MIPS, IRIX
- Commercial virtual machines for x86 architecture
 - VMware Workstation (now EMC) (1999-)
 - Connectix VirtualPC (now Microsoft)

A Return to Virtual Machines

- Research virtual machines for x86 architecture
 - Xen (SOSP '03)
 - plex86
- OS-level virtualization
 - FreeBSD Jails, User-mode-linux, UMLinux

Starting Point: A Physical Machine

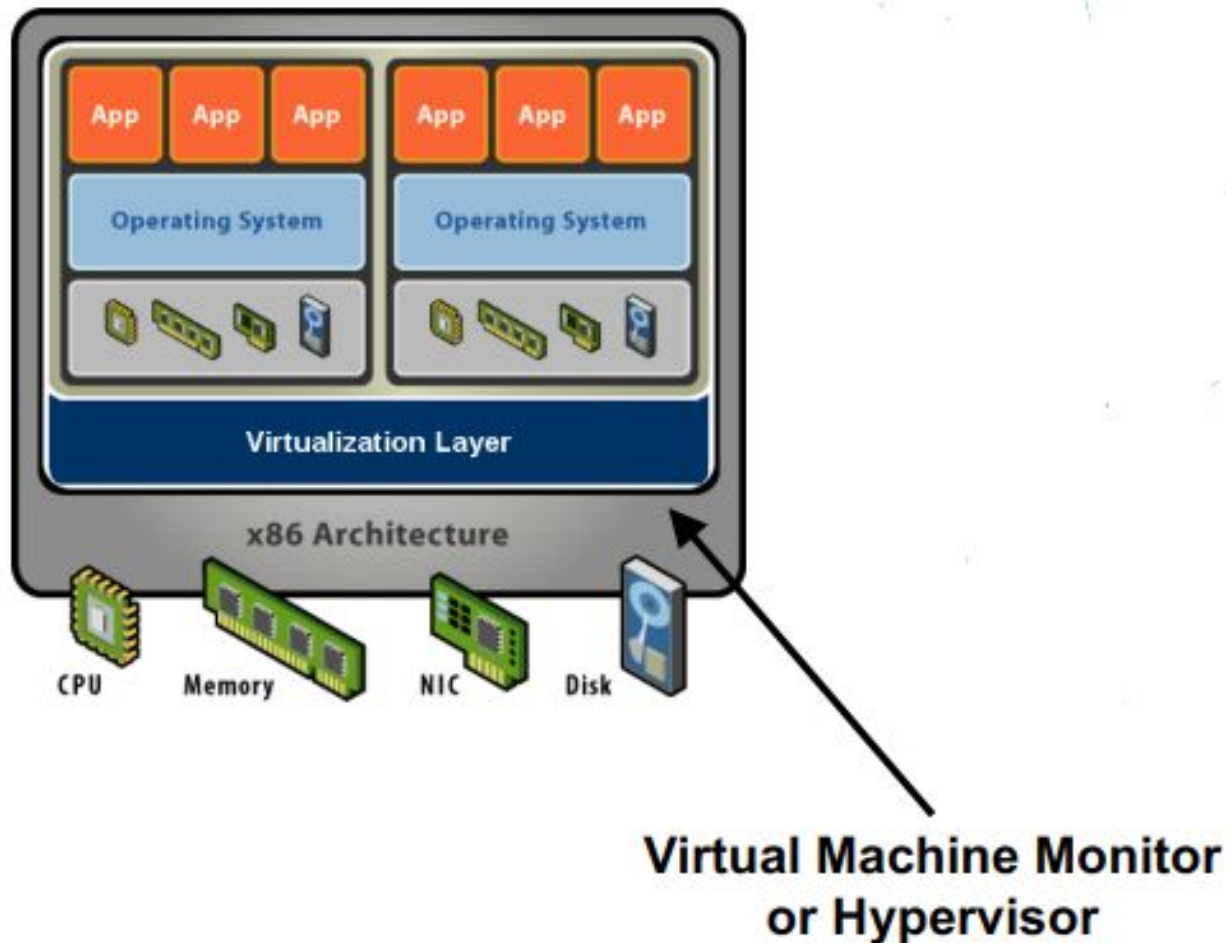
- Physical Hardware
 - Processors, memory, chipset, I/O devices, etc.
 - Resources often grossly underutilized
- Software
 - Tightly coupled to
- physical hardware
 - Single active OS instance
 - OS controls hardware



What is a Virtual Machine?

- Software Abstraction
 - Behaves like hardware (cek hardware atau software?)
 - Encapsulates all OS and application state
- Virtualization Layer
 - Extra level of indirection
 - Decouples hardware, OS
 - Enforces isolation
 - Multiplexes physical hardware across VMs

What is a Virtual Machine?



Virtualization Properties, Features

- Isolation
 - Fault isolation
 - Performance isolation (+ software isolation, ...)
- Encapsulation
 - Cleanly capture all VM state
 - Enables VM snapshots, clones

Virtualization Properties, Features

- Portability
 - Independent of physical hardware
 - Enables migration of live, running VMs (freeze, suspend,...)
- Interposition
 - Transformations on instructions, memory, I/O
 - Enables transparent resource overcommitment, encryption, compression, replication ...

Types of Virtualization

- Hardware
 - emulation – VM emulates/simulates complete hardware
 - QEMU
 - paravirtualization - software interface to virtual machines
 - Xen
 - full virtualization - complete simulation of the underlying hardware
 - VMWare, Parallels

Types of Virtualization

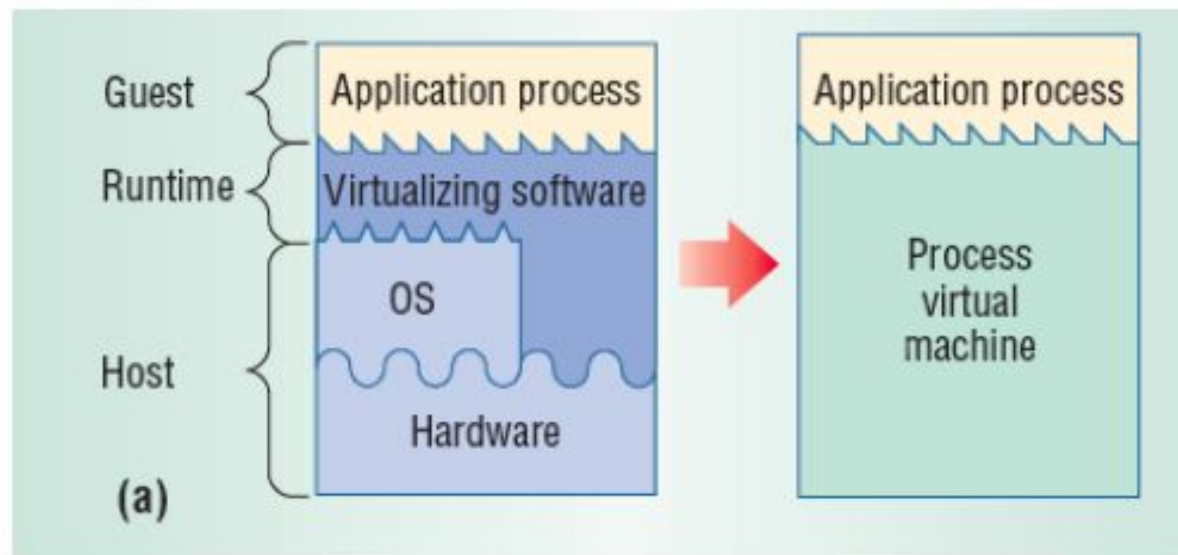
- Memory virtualization
 - decouples volatile random access memory (RAM) resources from individual systems
 - aggregates these resources into a virtualized memory pool available to any computer in the cluster
- Storage virtualization
 - abstracting logical storage from physical storage
 - NAS - network attached storage

Types of Virtualization

- Data virtualization
 - data as an abstract layer, independent of underlying database systems, structures and storage
- Network virtualization
 - virtualized network addressing space within or across network subnets
 - VPNs

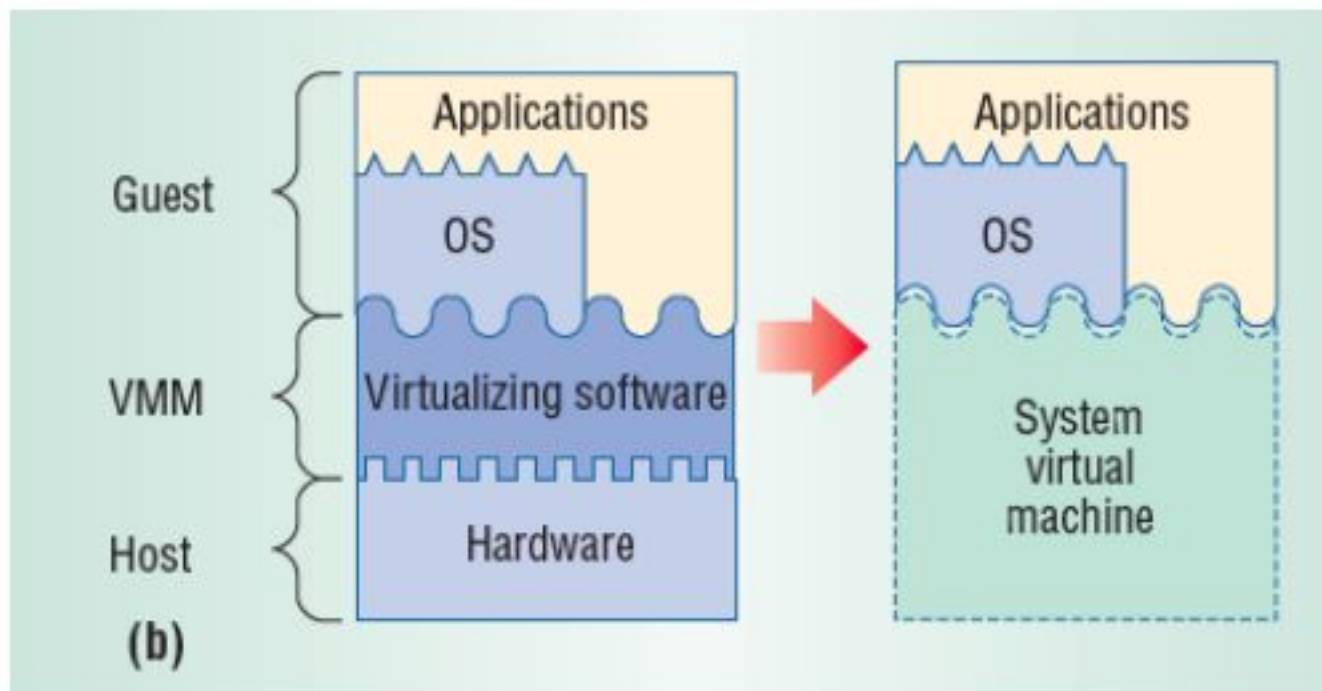
Types of Virtualization

- Process Virtualization
 - Language-level Java, .NET, Smalltalk
 - OS-level processes, Solaris Zones, BSD Jails, Docker Containers
 - Cross-ISA emulation Apple 68K-PPC-x86



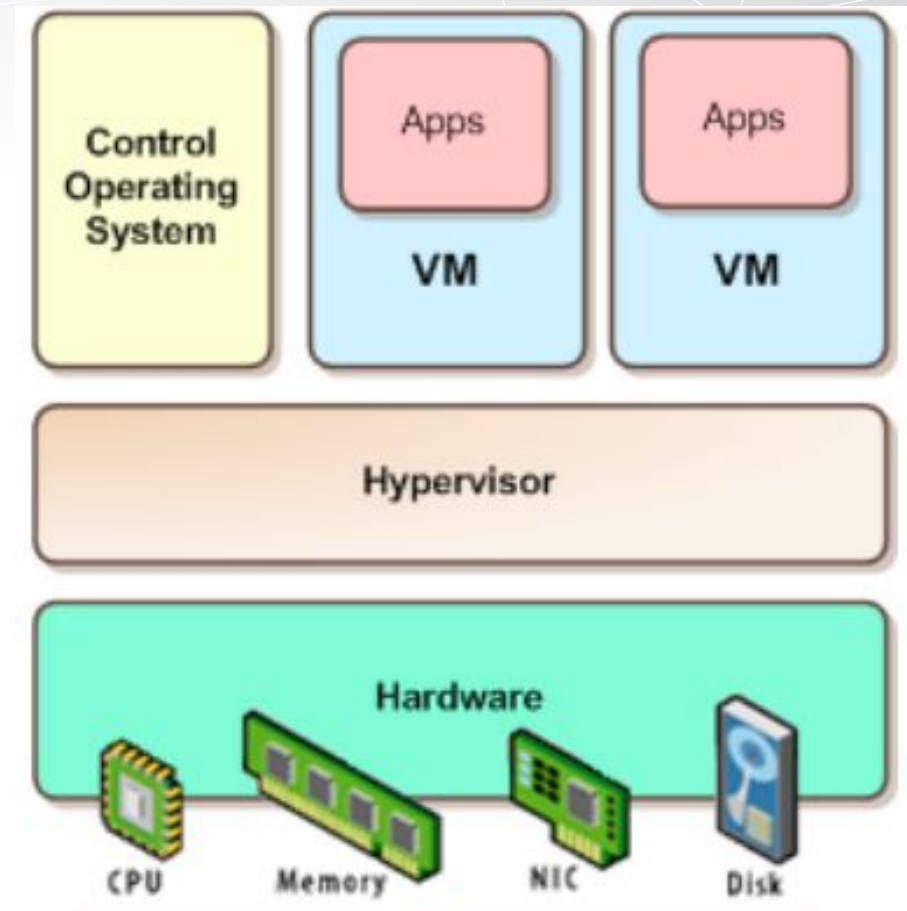
Types of Virtualization

- System Virtualization
 - VMware Workstation, Microsoft VPC, Parallels
 - VMware ESX, Xen, Microsoft Hyper-V



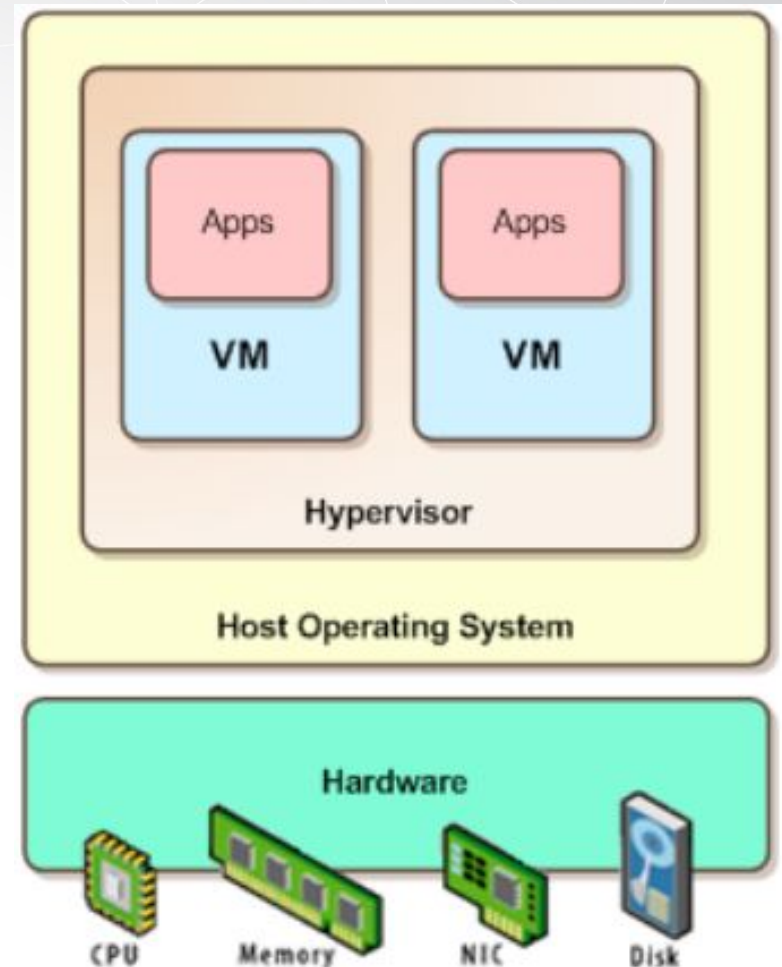
Types of System Virtualization

- Native/Bare metal (Type 1)
 - Higher performance
 - ESX, Xen, HyperV



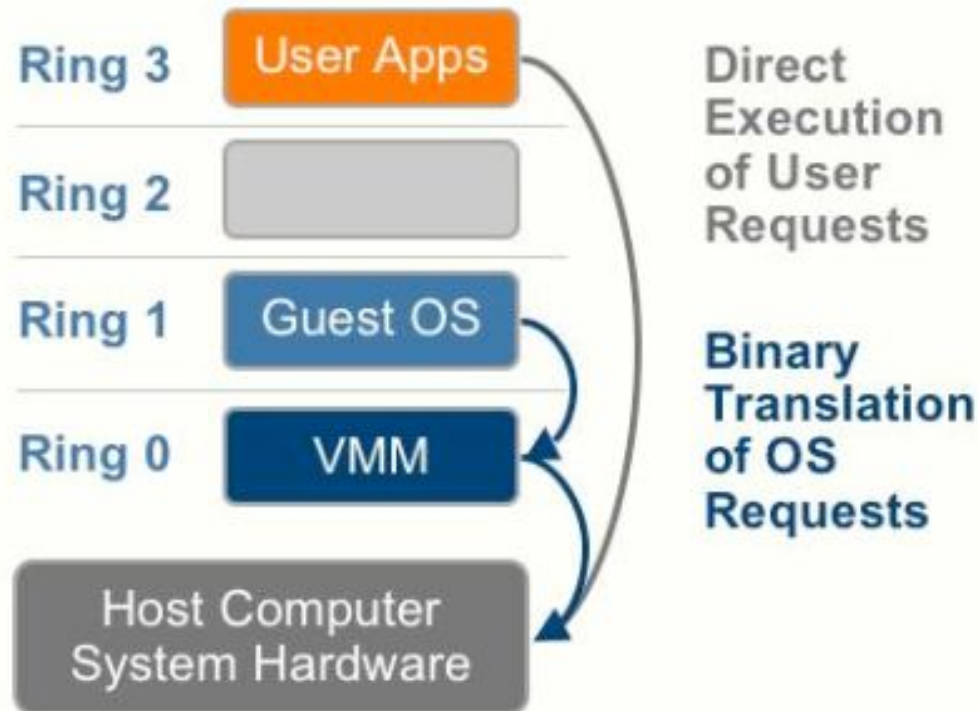
Types of System Virtualization

- Hosted (Type 2)
 - Easier to install
 - Leverage host's device drivers
 - VMware Workstation, Parallels



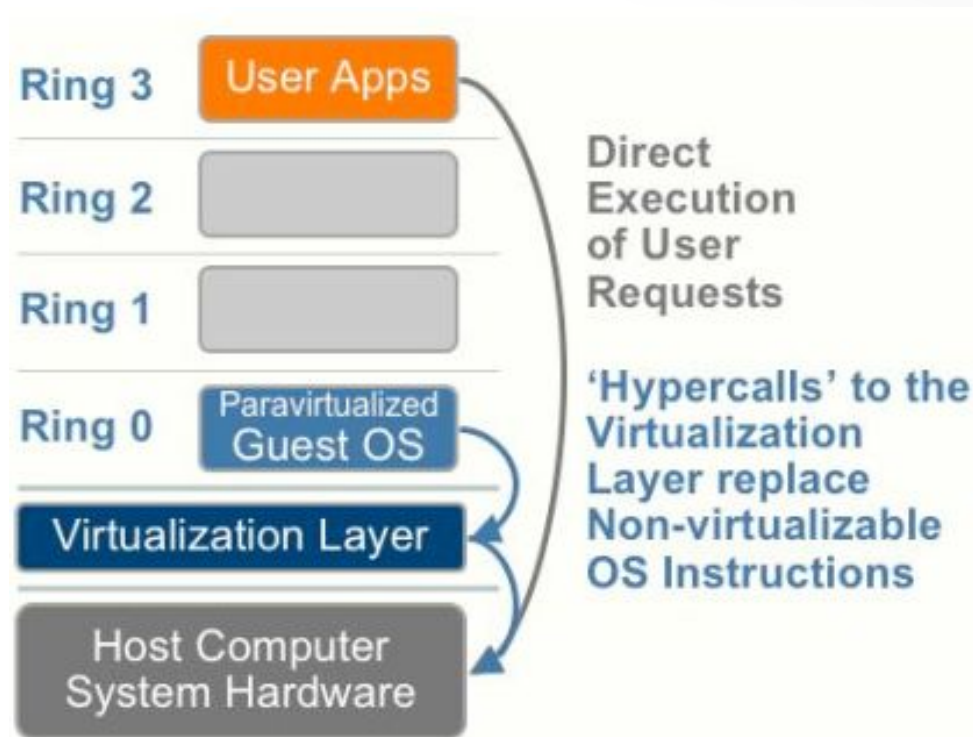
Types of Virtualization

- Full virtualization (e.g. VMWare ESX)
 - Unmodified OS, virtualization is transparent to OS
 - VM looks exactly like a physical machine



Types of Virtualization

- Para virtualization (e.g. XEN)
 - OS modified to be virtualized,
 - Better performance at cost of transparency



What is a Virtual Machine Monitor?

- Classic Definition (Popek and Goldberg '74)

A virtual machine is taken to be *an efficient, isolated duplicate* of the real machine. We explain these notions through the idea of a *virtual machine monitor* (VMM). See Figure 1. As a piece of software a VMM has three essential characteristics. First, the VMM provides an environment for programs which is essentially identical with the original machine; second, programs run in this environment show at worst only minor decreases in speed; and last, the VMM is in complete control of system resources.

What is a Virtual Machine Monitor?

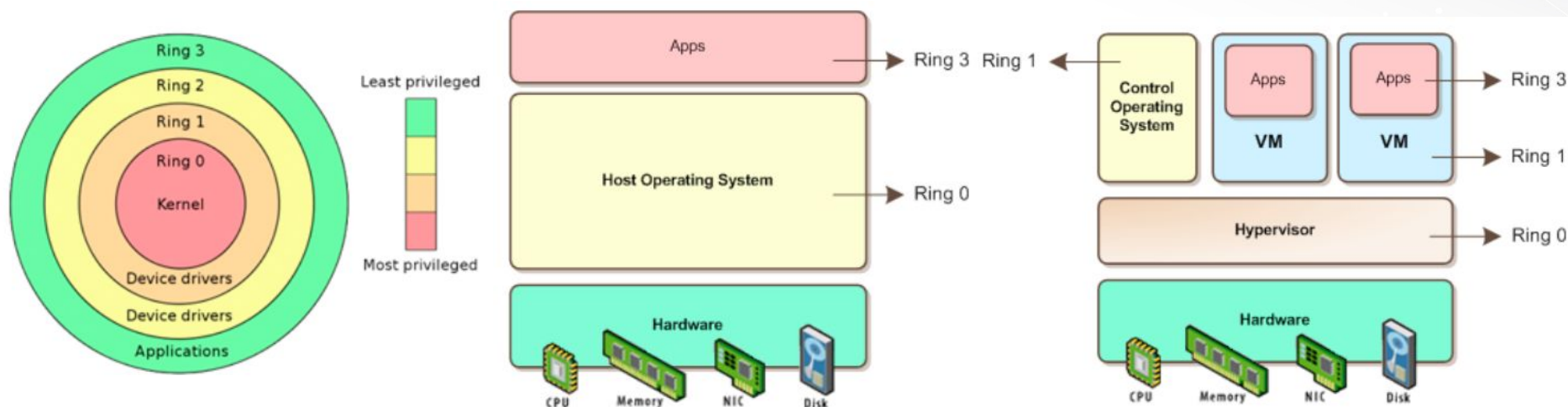
- VMM Properties
 - Equivalent execution
 - Performance
 - Safety and isolation

VMM Implementation Goals

- Should efficiently virtualize the hardware
 - Provide illusion of multiple machines
 - Retain control of the physical machine
- Which subsystems should be virtualized?
 - Processor => Processor Virtualization
 - Memory => Memory Virtualization
 - I/O Devices => I/O virtualization

Processor Virtualization

An architecture is classically/strictly virtualizable if all its sensitive instructions (those that violate safety and encapsulation).

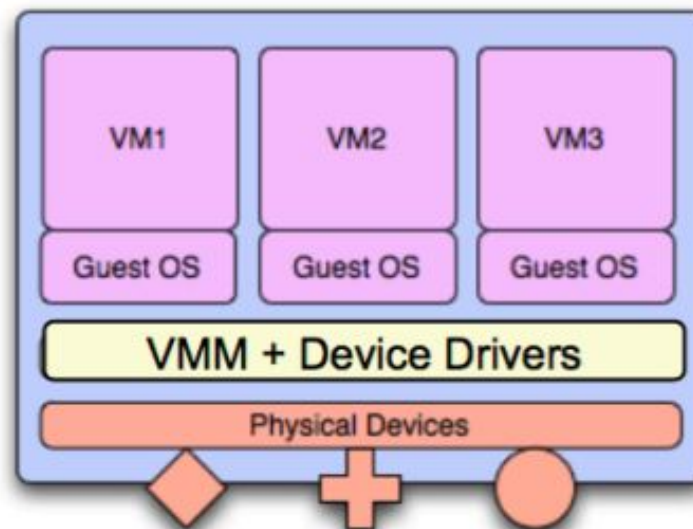
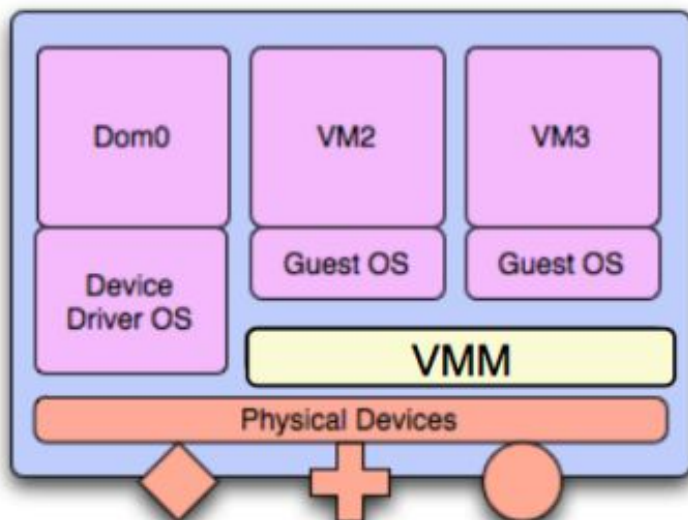


Shadow Page Tables

- Three abstractions of memory
 - Machine
 - Physical
 - Virtual
- In each VM, OS creates and manages page tables for its virtual address spaces without modification
 - But these page tables are not used by the MMU

I/O Virtualization

- Challenge
- Insight
- Solution



Virtualizing I/O Devices

- However, overall I/O is complicated for VMMs
 - Many short paths for I/O in OSes for performance
 - Better if hypervisor needs to do less for I/O for guests,
 - Possibilities include direct device access, DMA passthrough, direct interrupt delivery (need H/W support!)

Virtualizing I/O Devices

- Networking also complex as VMM and guests all need network access
 - VMM can **bridge** guest to network (direct access)
 - VMM can provide **network address translation (NAT)**
- NAT address local to machine on which guest is running
- VMM provides address translation to guest to hide its address



Bagian 3

Karakteristik Cloud Computing

NIST Essential Characteristics

- **On-demand self-service**

- a consumer can *unilaterally* provision computing capabilities *without human interaction* with the service provider
- computing capabilities
 - server time, network storage, number of servers etc.

NIST Essential Characteristics

- **Broad network access**
 - capabilities are
 - available over the network
 - accessed through standard mechanisms
 - promote use by
 - heterogeneous thin or thick client platforms

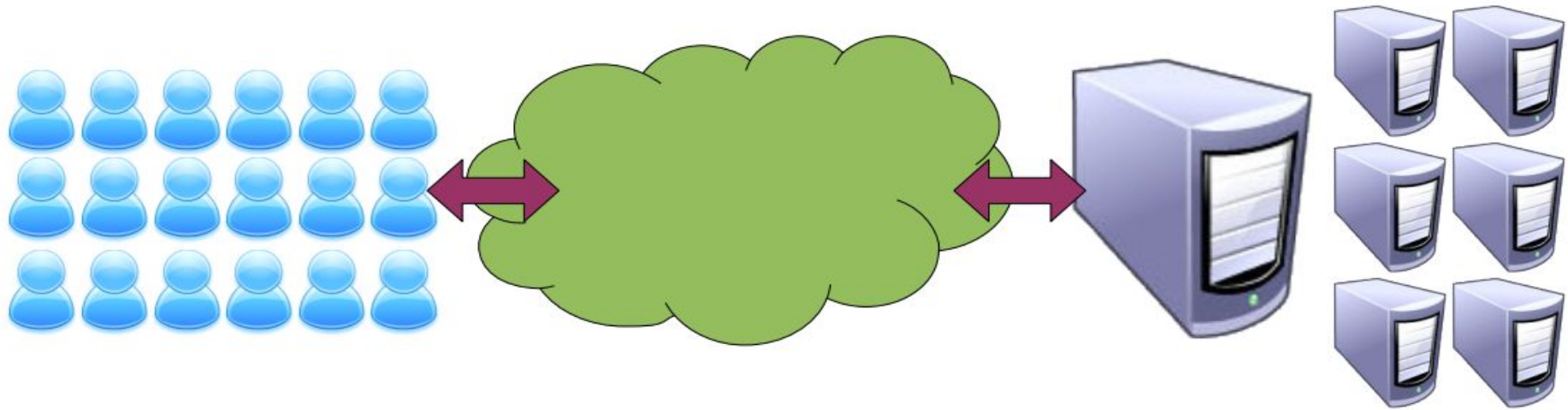
NIST Essential Characteristics

- **Multi-tenancy / Resource pooling**
 - provider's computing resources are pooled to serve multiple consumers
 - computing resources
 - storage, processing, memory, network bandwidth and virtual machines

NIST Essential Characteristics

- location independence
 - no control over the exact location of the resources
- has major implications
 - performance, scalability, security

NIST Essential Characteristics



- **Rapid elasticity**

- capabilities can be rapidly and elastically provisioned
- unlimited virtual resources
- predicting a ceiling is difficult

NIST Essential Characteristics

- **Measured service**
 - metering capability of service/resource abstractions
 - storage
 - processing
 - bandwidth
 - active user accounts
- OK so what happened to utility computing – pay as you go model??
 - more on this later when we discuss deployment models

Basic Cloud Characteristics

- The “**no-need-to-know**” in terms of the underlying details of infrastructure, applications interface with the infrastructure via the APIs.
- The “**flexibility and elasticity**” allows these systems to scale up and down at will
 - utilising the resources of all kinds
 - CPU, storage, server capacity, load balancing, and databases

Basic Cloud Characteristics

- The “**pay as much as used and needed**” type of utility computing and the “**always on, anywhere and any place**” type of network-based computing.
- Cloud are transparent to users and applications, they can be built in multiple ways
 - branded products, proprietary open source, hardware or software, or just off-the-shelf PCs.

Basic Cloud Characteristics

- In general, they are built on clusters of PC servers and off-the-shelf components plus Open Source software combined with in-house applications and/or system software.

Cloud computing takes virtualization to the next step

- You don't have to own the hardware
- You “rent” it as needed from a cloud
- There are public clouds
 - e.g. Amazon EC2, and now many others (Microsoft, IBM, Sun, and others ...)
- A company can create a private one
 - With more control over security, etc.

Goal 1 – Cost Control

- Cost
 - Many systems have variable demands
 - Batch processing (e.g. New York Times)
 - Web sites with peaks (e.g. Forbes)
 - Startups with unknown demand (e.g. the *Cash for Clunkers* program)
 - Reduce risk
 - Don't need to buy hardware until you need it

Goal 2 - Business Agility

- More than scalability - ***elasticity***
 - Ely Lilly in rapidly changing health care business
 - Used to take 3 - 4 months to give a department a server cluster, then they would hoard it
 - Using EC2, about 5 minutes
 - And they give it back when they are done
- Scaling back is as important as scaling up

Goal 3 - Stick to Our Business

- Most companies don't WANT to do system administration
 - Forbes says:
 - *We are is a publishing company, not a software company*
- *But beware:*
 - *Do you really save much on sys admin?*
 - *You don't have the hardware, but you still need to manage the OS!*

Cloud Computing Characteristics

- Common Characteristics:

Massive Scale

Resilient Computing

Homogeneity

Geographic Distribution

Virtualization

Service Orientation

Low Cost Software

Advanced Security

Cloud Computing Characteristics

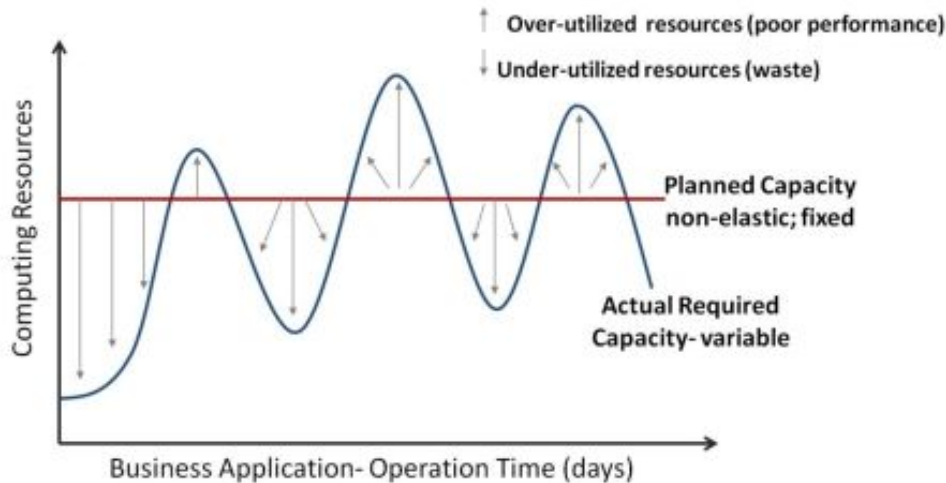
- Essential Characteristics:



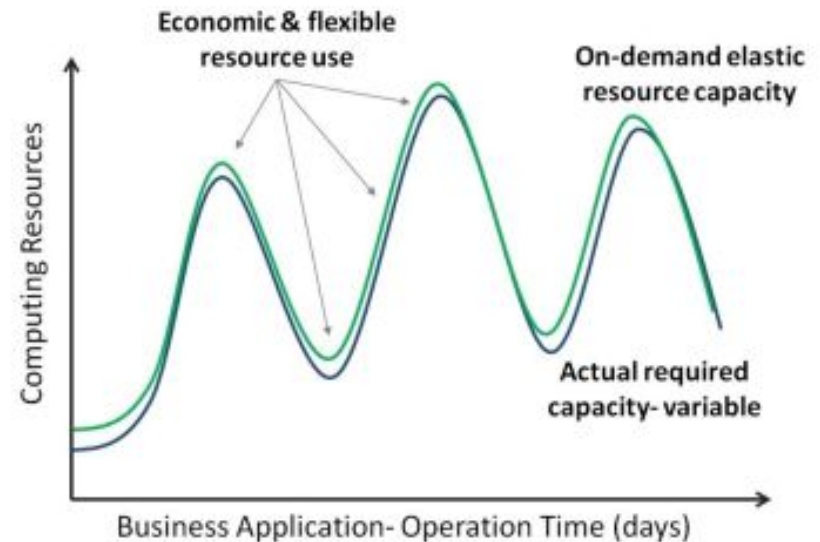
Elasticity – Cloud Computing

Elasticity - Hosting Vs. IaaS Cloud

(a) Traditional Infrastructure Model



(b) Cloud Infrastructure Model



- On-demand computing resources – e.g., servers, storage
- Efficient use of resources – pay per usage time (pay-as-you-go)

What is Elasticity (Auto-Scaling)?

- The ability of a system to dynamically adapt its underlying computing infrastructure resources in response to variable workload changes over time
- Can be at SaaS, PaaS, IaaS
- IaaS Elasticity
 - Adding/removing virtual or physical servers
 - Increasing/decreasing CPU, memory and storage capacity by adding/removing additional hardware components to existing machines

What is Elasticity (Auto-Scaling)?

- Increasing/decreasing network speed and number of IP addresses
 - Increasing/decreasing amount of data transfer and number of data operations/requests of cloud resources
-
- Manual (user interface) vs. automated means (APIs)
 - Auto-scaling

IaaS Elasticity and Web Applications

- Key characteristics of Web applications
 - Highly transactional - business value
 - Commodity - Variable workload patterns
- IaaS cloud
 - On-demand computing resources/services – pay-as-you-go

IaaS Elasticity and Web Applications

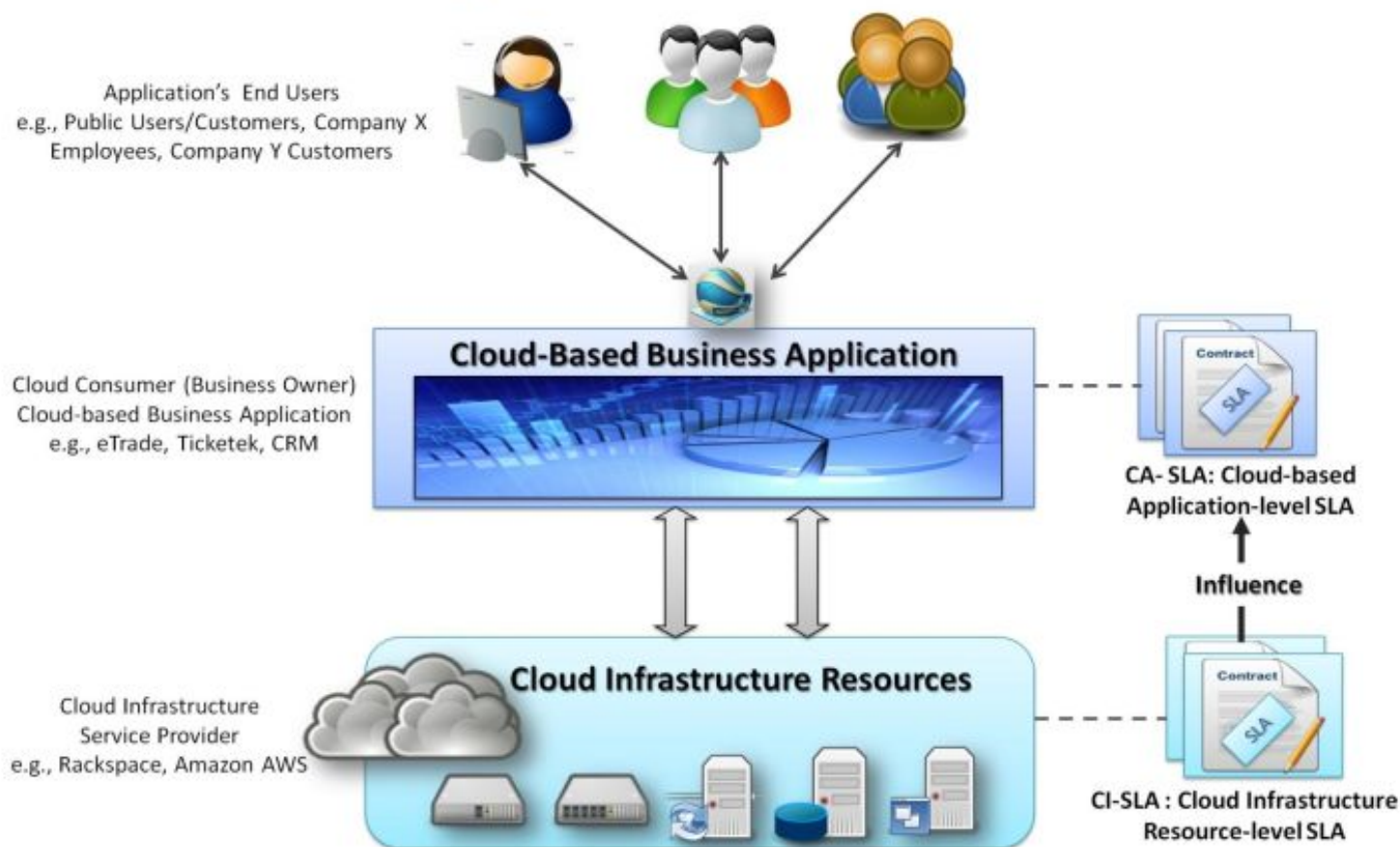


Case Study – Animoto AWS Elasticity

- Animoto an online video service, makes it easy to make and share videos in just a few minutes
- The company launched in 2007 using its own servers, but moved to AWS for additional capacity
- When Animoto integrated with Facebook in 2008, attracting 750,000 new users in 3 days, it used AWS to handle the load.

Case Study – Animoto AWS Elasticity

Cloud-based & Application-based SLA*



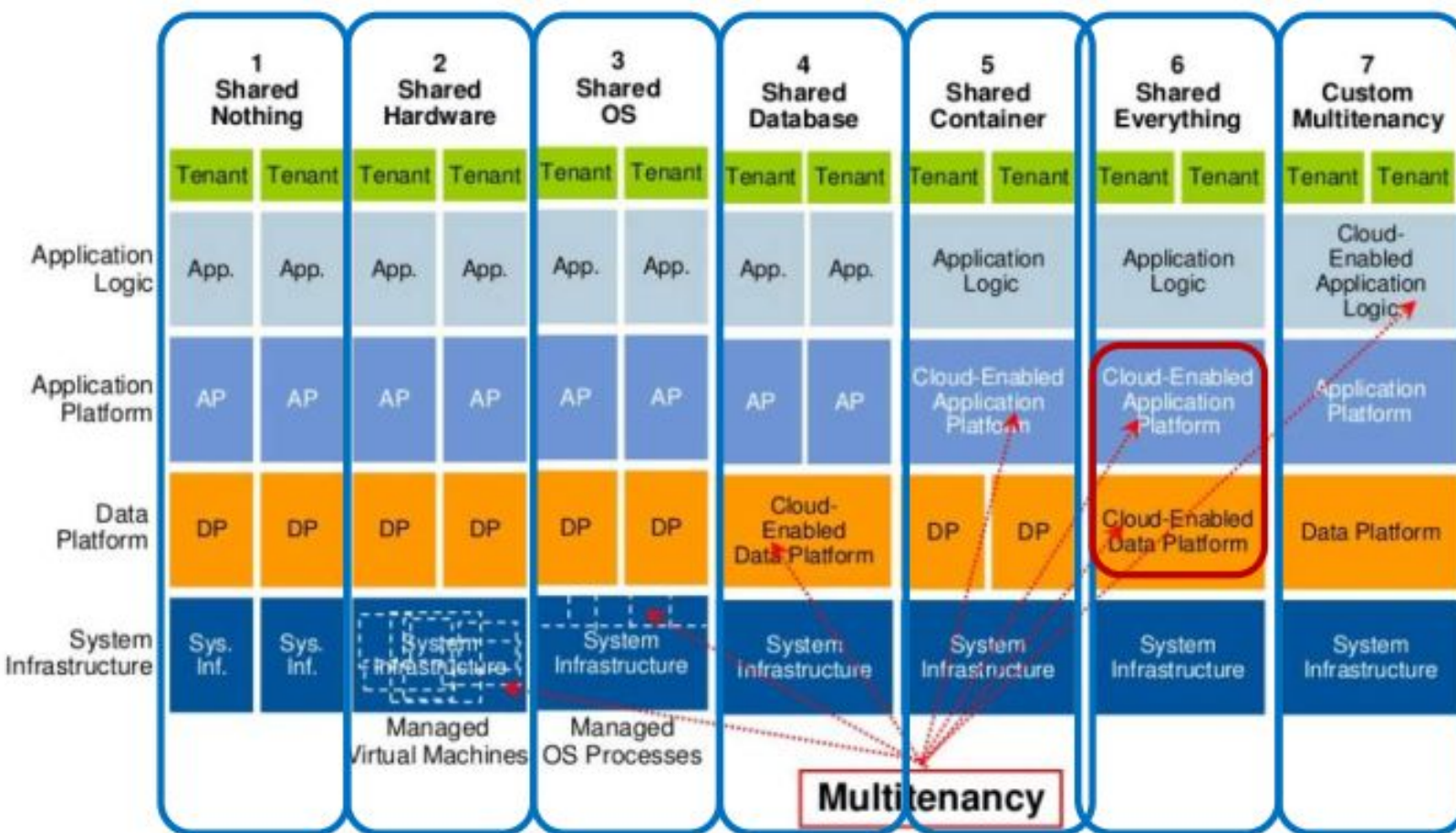
Characteristics of Multi-Tenancy

1. Isolation
2. Scaling conveniently with the number and size of tenants
3. Meet SLAs for each tenant
4. Support for per-tenant service customization
5. Support for value-adding ops, e.g., backup, upgrade
6. Secure data processing and storage
7. Support for regulatory law (per legislator, per tenant)

Benefits of Multi-Tenancy (the Promise)

- **Cloud operator**
 - Economy of scale
 - Market-share and branding (for the moment)
- **Users**
 - Flexibility
 - Focus on core expertise
 - Reduced cost
 - Reduced time-to-market
- **Overall**
 - Reduced cost of IT deployment and operation

Architecture For Multitenancy





Cloud Concepts Overview

Introduction to the AWS Cloud

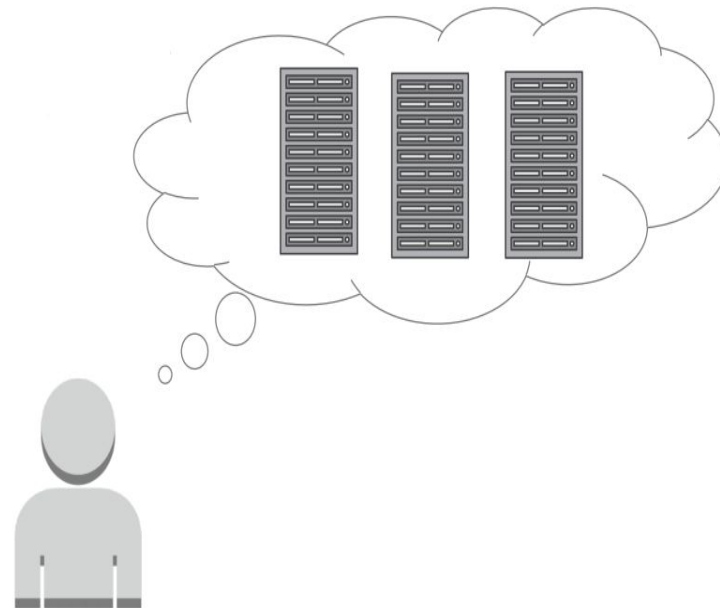


- Cloud Computing (Komputasi Cloud)
 - ✓ On-demand delivery of IT resources and applications via the internet with pay-as-you-go pricing

Before AWS

AWS Architecting

- Guessing theoretical
 - ✓ Is there enough res
 - ✓ Is this sufficient sto



With AWS

• With AWS:

- ✓ Servers
- ✓ Databases
- ✓ Storage
- ✓ Higher-level applications



With AWS

- Resources can be:
 - ✓ Initiated within second
 - ✓ Treated as “temporary and disposable”
- Free from the inflexibility and constraints



AGILITY

3 Factors :

- Speed
- Experimentation
- Cultur of innovation

Agility: Increase Speed and Global Reach

- Instant global reach
- Rapid availability of new resources



Agility: Increase Experimentation

- AWS enables
 - ✓ Operations as code
 - ✓ Safe Experimentation
 - ✓ Comparative testing



Agility: Increase Innovation

- Quick experimentation with low cost/risk
- More experimentation and more often

Agility: The AWS Infrastructure

- Instant elasticity-
- Scalability-
- Flexible
- Reliability
- Secure-



Regions and Availability Zones



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Edge Locations



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High Availability

- High availability
 - ✓ Functional and accessible system
 - ✓ Minimized downtime
 - ✓ No human intervention

Fault Tolerance

- Fault Tolerance:
 - ✓ Operational applications during component failure
 - ✓ Built-in redundancy of components

Elasticity, Scalability, and High Performance

AWS

- Elastic infrastructure
- Innovative new services/products
- Deployment in multiple regions
 - ✓ Lower latency
 - ✓ Better customer experience

Elasticity, Scalability, and High Performance

Customer

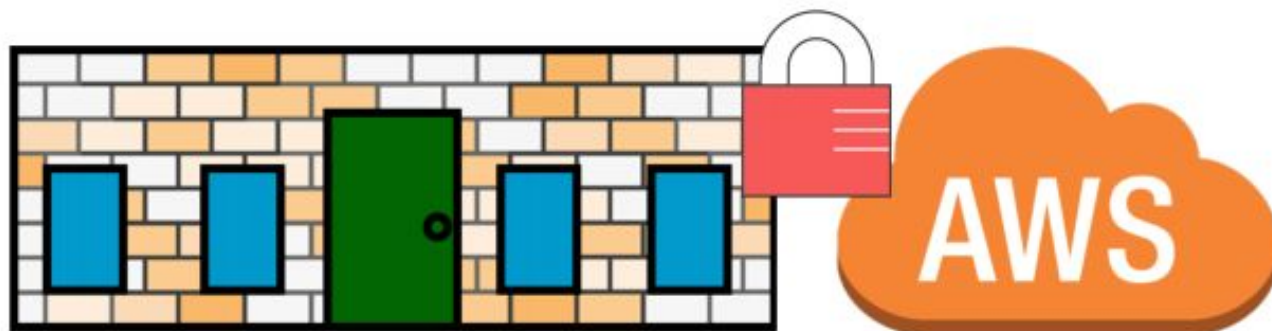
- Use services at your own pace
- Use tools to meet your needs
- Adapt your consumption
 - ✓ Scale up as workload grows
 - ✓ Shutdown unneeded resources
 - ✓ Use Auto Scaling

Security and Compliance

- You retain control over region where data is located
- Security auditing
 - Periodic and manual
- AWS cloud offer capabilities
 - For governance
 - To meet the strictest security requirements



Security and Compliance



- Latest electronic surveillance
- Multi-factor access control systems
- Trained security guards 24/7

Reliability

- High-performing and reliable solutions
- Achieve greater flexibility/capacity
- Reliability:
 - ✓ Recover from failures
 - ✓ Resources that demand and mitigate disruptions
- Must have well-planned foundation
 - ✓ Reduce uncertainty of forecasting
 - ✓ Detect failure and automatically heal itself
- Unmatched by on-premise solutions



Pricing: Pay as you go

- Benefits
 - ✓ Redirect focus to innovation and invention
 - ✓ Adapt to changing business needs
 - ✓ Improve responsiveness to changes
 - ✓ Reduce risk or overprovisioning or missing capacity



Conclusion

- Connect with customers
- Develop ground-breaking new insights
- Scientific breakthroughs
- Deliver innovative new products





LATIHAN

