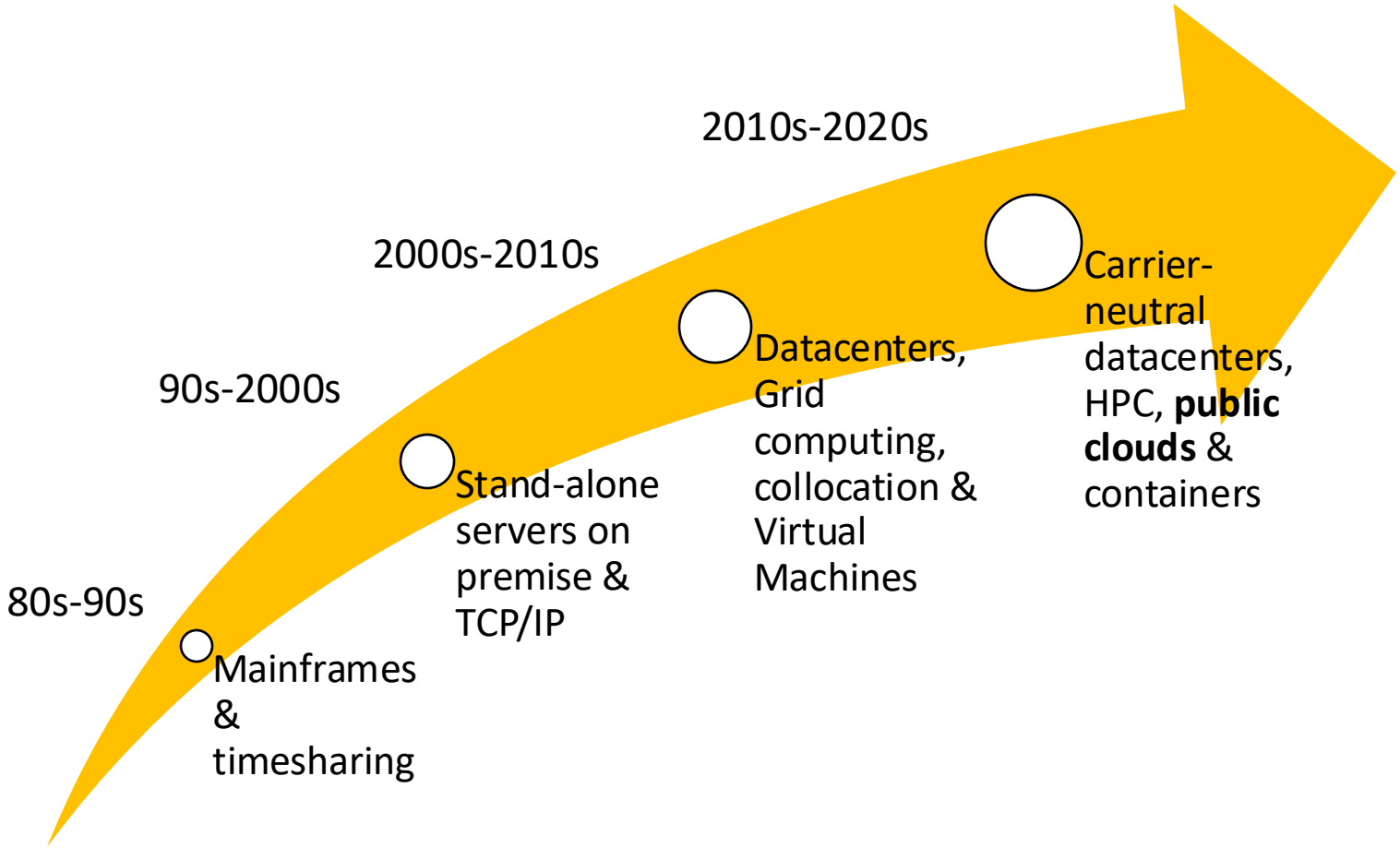
Virtualization & Cloud

Author:
Sami Ait Ali Oulahcen

Nouakchott, Mauritania
17-22 February 2025

Evolution of computing



Virtualization VS Cloud

Virtualization

- Single tenant
- VMs and containers
- Partially redundant (disk redundancy, node redundancy, might/should have remote backup location for disaster recovery)
- On-premise or collocation
- Sometimes called **private cloud**

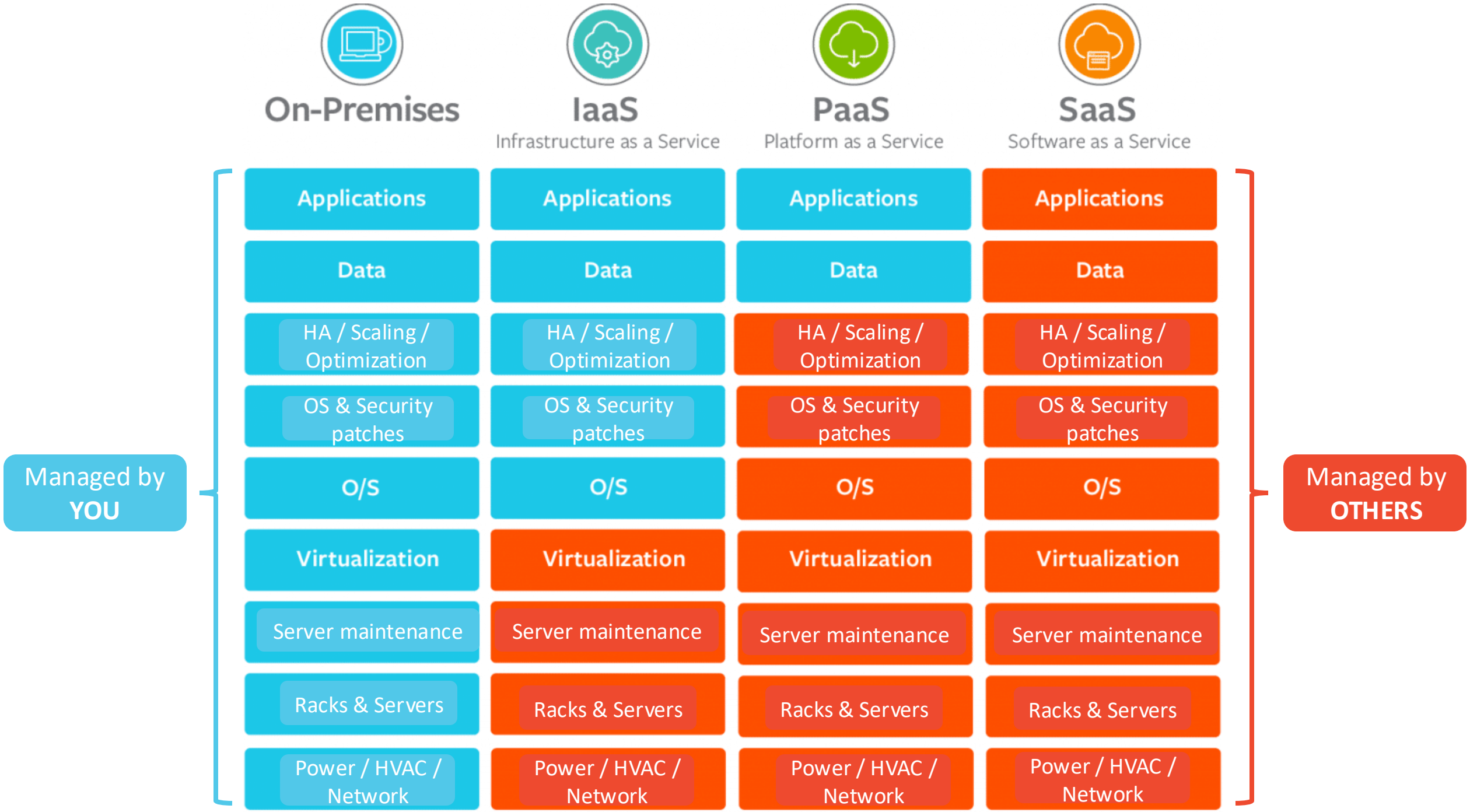
Cloud

- Multi-tenant
- IaaS: virtual infrastructure (networks, routers/switches, firewalls, machines), PaaS, CaaS, FaaS
- Highly Redundant (disks, nodes, regions, HA over multiple locations)
- Public or hybrid

On premise VS cloud comparison

- Building a new house (On-premise)

- Renting a house (cloud), furnished (PaaS), hotel room all inclusive (SaaS)


On-Premises
IaaS
Infrastructure as a Service
PaaS
Platform as a Service
SaaS
Software as a Service
Applications
Data
HA / Scaling / Optimization
OS & Security patches
O/S
Virtualization
Server maintenance
Racks & Servers
Power / HVAC / Network
Managed by YOU
Managed by OTHERS

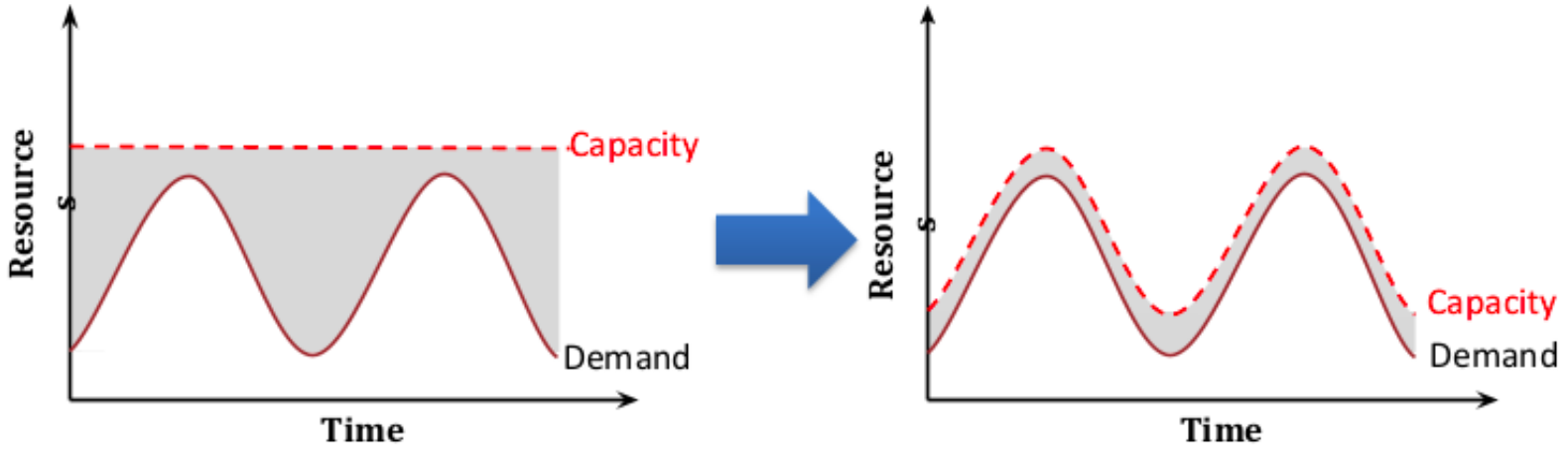
Cloud is infrastructure you don't manage.

What are we trying to solve with cloud computing ?

- Remove infrastructure overhead, concentrate on product
- Faster time to market
- Use of cloud-native development: break applications to a collection of small, independent microservices and employ methodologies like declarative APIs, DevSecOps, and CI/CD.

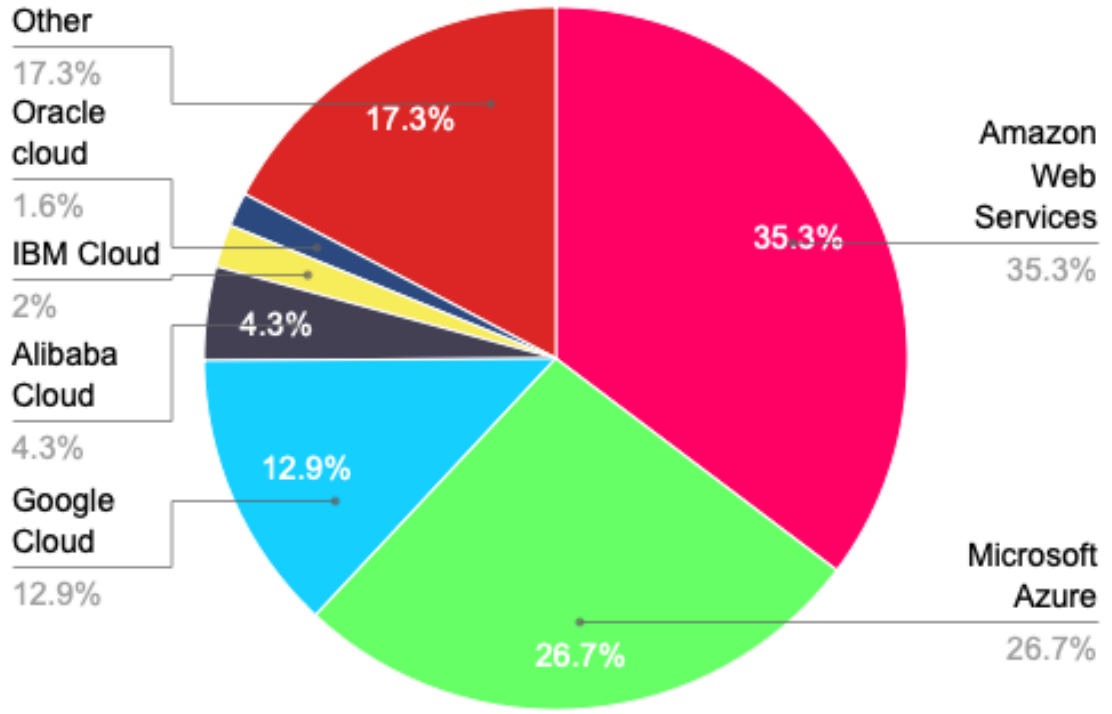
What are we trying to solve with cloud computing ?

- Variance in usage vs. resources (underusage, bursts)
- **Pay as you go model** (dynamic provisioning) provides scalability & elasticity



Public cloud landscape

- Global public cloud services market estimated at $256.7 billion in 2023 (0). The top public cloud providers and their estimated revenue in 2023 are:
- AWS: $90.8 billion (1)
- Microsoft Azure: $68.1 billion (2)
- Google Cloud: $33 billion (3)
- Alibaba Cloud: $11.2 billion (4)
- IBM Cloud: $5.1 billion (5)
- Oracle cloud: $4.4 billion (6)



Public cloud offerings

CLOUD PROVIDER	IAAS	OBJECT STORAGE	MANAGED DATABASE	FAAS	CAAS	API MANAGEMENT	NETWORKING AND SECURITY
AWS	Elastic Compute Cloud (EC2)	Simple Storage Service (S3)	Relational Database Service (RDS)	Lambda	Elastic Container Service (ECS)	API Gateway	Virtual Private Cloud (VPC)
Azure	Virtual Machines	Blob Storage	Azure SQL Database	Azure Functions	Azure Kubernetes Service (AKS)	Azure API Management	Azure Virtual Network
GCP	Compute Engine	Cloud Storage	Cloud SQL	Cloud Functions	Google Kubernetes Engine (GKE)	Cloud Endpoints	Virtual Private Cloud (VPC)

Public/multi-tenant cloud software

- Major (open-source) players:

  OpenStack: a modular cloud platform offering IaaS made of several independently deployed components like Nova (compute), Swift (object storage), Cinder (block storage), Neutron (networking)

  Kubernetes: a container orchestration platform automating deployment, scaling, and management of containerized applications

  CloudStack: a monolithic cloud platform offering IaaS developed and maintained by Apache Software Foundation

- Commercial contenders: Huawei Cloud Stack (OpenStack based), Redhat's OpenShift (Kubernetes based), VMware vCloud Director

Private cloud

Private cloud solutions

- Major FOSS players: Proxmox, oVIRT
- Major commercial players: Nutanix, Vmware, HyperV

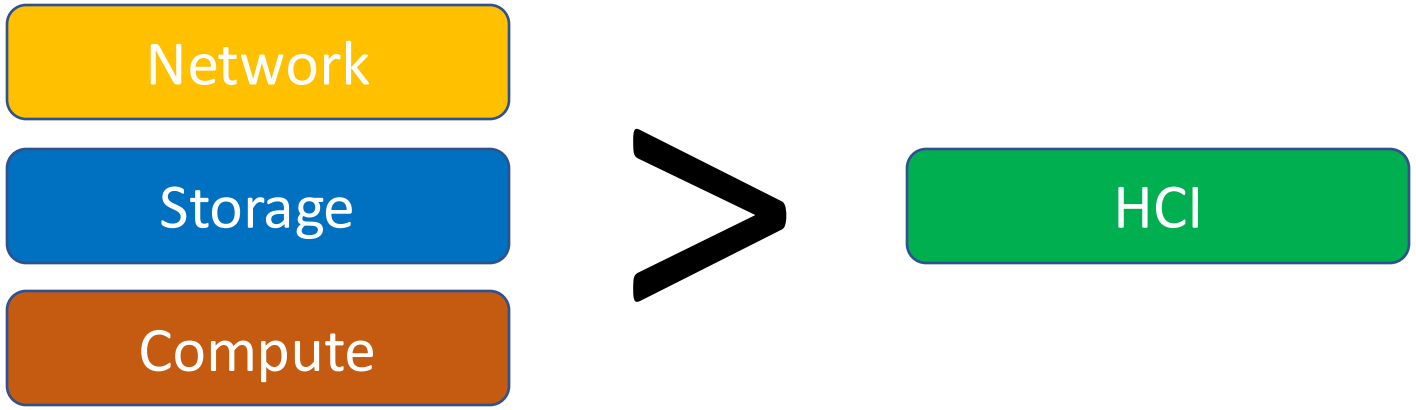
To build a private cloud

Multiple building block for are needed for a private cloud:

- Datacenter: dedicated building/room with dual power supplies / UPS / generators, AC, fire extinguisher system, physical access control. For small deployments, integrated racks can cover a lot of the above
- **Qualified human resources** to manage the datacenter
- Redundant high capacity network
- Compute nodes, management nodes, and storage nodes
- Virtualization/private cloud software
- Backup and disaster recovery

Hyperconvergence

- In a Hyper-Converged Infrastructure (HCI) setup, compute, storage, and networking are integrated into a single platform
- Gain in simplicity: easier management and maintenance
- Gain in cost: reduces capital (less servers to buy) and operational expenses



Planning

- How many VMs do you need ?
- Evaluate resources needed:
- CPU: 1-4 vCPUs per VM (1 CPU core = 2 vCPUs)
  + extra CPU cores for system services
- RAM: 1-4GB per conventional VM (less for CT) - choose you average
  + 1GB RAM per drive for storage management and I/O
  + extra RAM for system services
- Storage: SSD preferable if you can afford
  Facture in replication (if you need 2TB get 4TB)
  No RAID controller if using Ceph

Planning

- Network: Dedicated high speed interface(s) for storage network
  Dedicated interface for management
  Dedicated interface(s) for VM networks

- Plan for an **odd number** of nodes to have quorum: 3 or 5 or 7

Backup & Recovery

- A private cloud is not complete without data backup and recovery
- Backups are the last line of defense against data loss
- Keeping multiple versions of backup protects you against data corruption or accidental deletion
- Perform regular recovery scenarios

Disaster recovery plan

- Can be part of a Business Continuity Plan: the process of ensuring that critical business functions can react and recover from any disruption with minimal impact
- Identify critical data/assets
- Backup critical data/assets in a remote location to account for disasters like flood or fire. Determine the backup frequency
- Regularly test your disaster recovery plan

Hybrid cloud

- A hybrid cloud is an environment that combines public and private cloud services
- Data sovereignty with scaling
- Accommodate sudden bursts while keeping data local
- Can be used for offsite Data Backup and Recovery as well

Questions ?

Annex

New cloud concepts for someone coming from virtualization (1)

- **Infrastructure as a Service (IaaS):** in the cloud computing model not only servers are virtualized but also storage and networks
- **Multi-tenancy**: Cloud computing platforms provide multi-tenancy, meaning that multiple organizations can share the same physical resources while maintaining isolation and security
- **Scalability**: Cloud computing platforms provide the ability to easily scale virtual resources up or down as needed, without requiring manual intervention. This is different from traditional virtualization where scaling typically requires the admin's intervention

New cloud concepts for someone coming from virtualization (2)

- **Identity and Access Management**: access management is typically fine-grained in cloud platforms, which means each user is given the exact rights they need
- **Self-service portal:** This fine-grained IAM also allows for a self-service portal where users can provision and manage their own virtual resources without requiring IT intervention
- **Images:** Images are pre-configured virtual machine templates that can be used to quickly provision new virtual machines
- **Block Storage**: type of storage that provides persistent storage volumes to virtual machines
- **Object Storage**: type of storage that provides a scalable and durable storage solution for unstructured data

New cloud concepts for someone coming from virtualization (3)

- **Security Groups**: virtual firewalls that control inbound and outbound traffic to virtual machines. In cloud platforms, typically all traffic is blocked until you apply a security group
- **Floating IPs**: virtual IP addresses that can be associated with virtual machines to provide high availability and load balancing

Sources

- (0) https://www.idc.com/getdoc.jsp?containerId=prUS52343224
- (1) https://ir.aboutamazon.com/news-release/news-release-details/2024/Amazon.com-Announces-Fourth-Quarter-Results/default.aspx
- (2) https://www.microsoft.com/investor/reports/ar23/index.html
- (3) https://www.abc.xyz/assets/52/88/5de1d06943cebc569ee3aa3a6ded/goog023-alphabet-2023-annual-report-web-1.pdf
- (4) https://data.alibabagroup.com/ecms-files/1479231421/aa56f379-6717-4afc-9005-b8a695c7fd95/Alibaba%20Group%20Holding%20Limited%20Fiscal%20Year%202023%20Annual%20Report.pdf
- (5) https://investors.ibm.com/press/Pages/default.aspx
- (6) https://investor.oracle.com/investor-news/news-details/2023/Oracle-Announces-Fiscal-2023-Fourth-Quarter-and-Fiscal-Full-Year-Financial-Results/default.aspx