Cloud Computing

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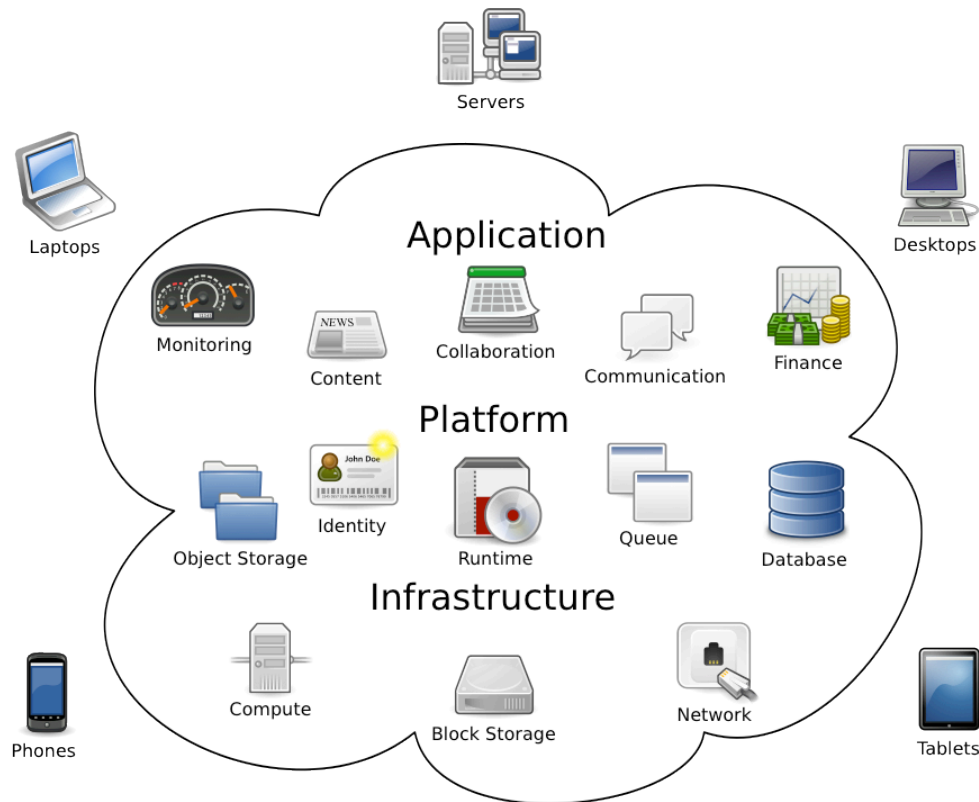# Is Cloud the answer to everything?
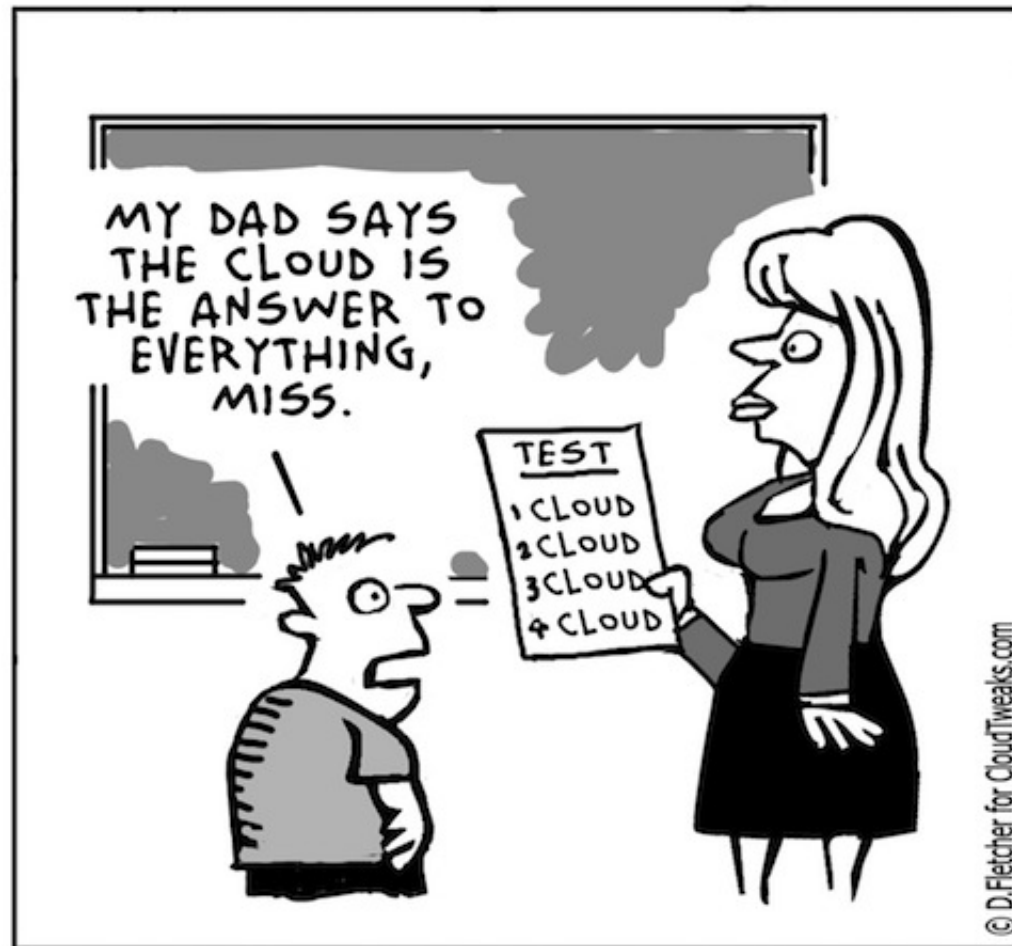
Agenda

■ What is Cloud Computing

■ Cloud Infrastructure

■ Cloud Applications

■ Cloud Application Paradigms

■ Conclusion

What is Cloud Computing

The public network or Internet is always drawn as a cloud
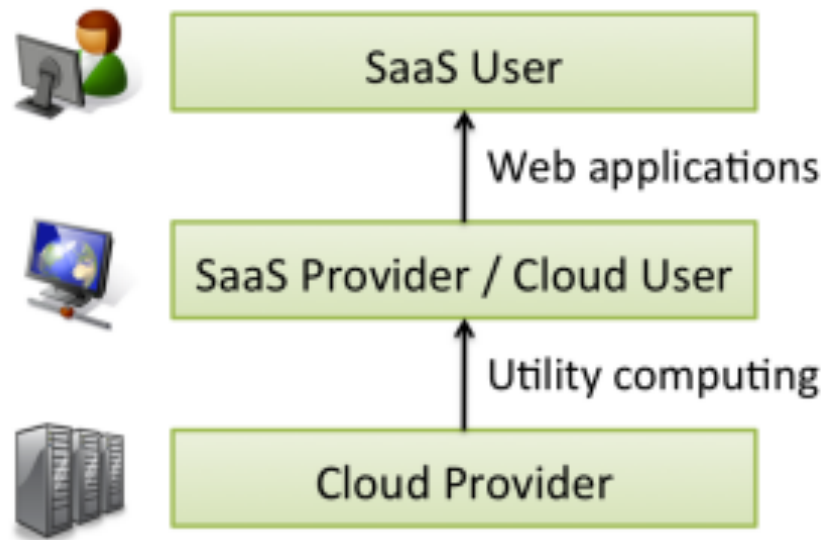
What is Cloud Computing

Everything – from computing power to computing infrastructure, applications, business processes to personal collaboration - can be delivered to you as a service wherever and whenever you need

What is Cloud Computing

- ◘ Infrastructure as a service (IaaS)
- ◘ Platform as a service (PaaS)
- ◘ Software as a service (SaaS)
- ◘ Storage as a service (STaaS)
- ◘ API as a service (APIaaS)
- ◘ *aaS

Made possible by Utility Computing

What is Cloud Computing

What is Cloud Computing

What is Cloud Computing

Cloud Data Centre

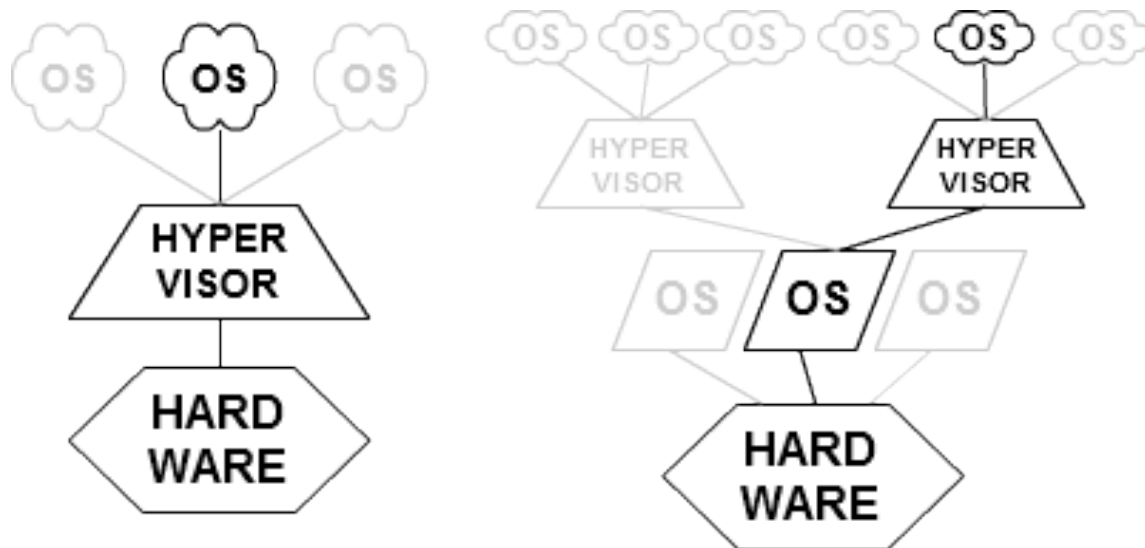# What is Cloud Computing

- Public Cloud
  - Is made available in a pay-as-you-go manner to the public

- Private Cloud
  - Internal datacenters of a business or other organisation that are not made available to the public

Machine Virtualisation

Virtual machine: A hardware virtualisation technology based implementation of a machine that executes programs like a physical machine

Machine Virtualisation

- One of major driving forces for Cloud computing
  - System security, as it allows isolation of services running on the same hardware
  - "Performance isolation"
  - Elasticity, hardware resources are pooled and managed by software
  - Performance and reliability, as it allows applications to migrate from one platform to another;

VM Live Migration

To move a running virtual machine or application between different physical machines without disconnecting the client or application
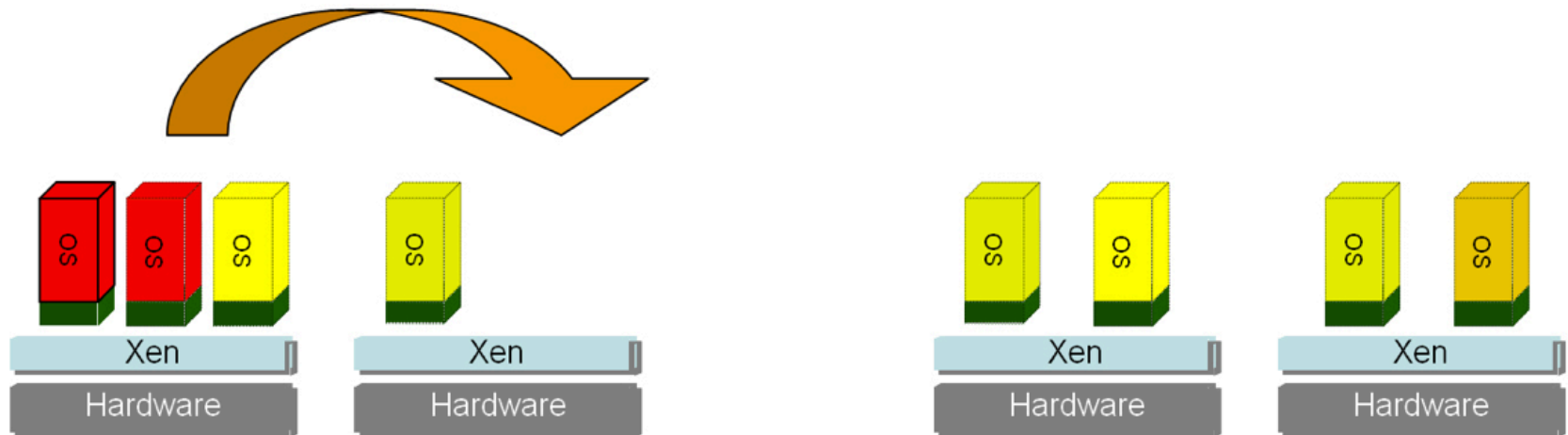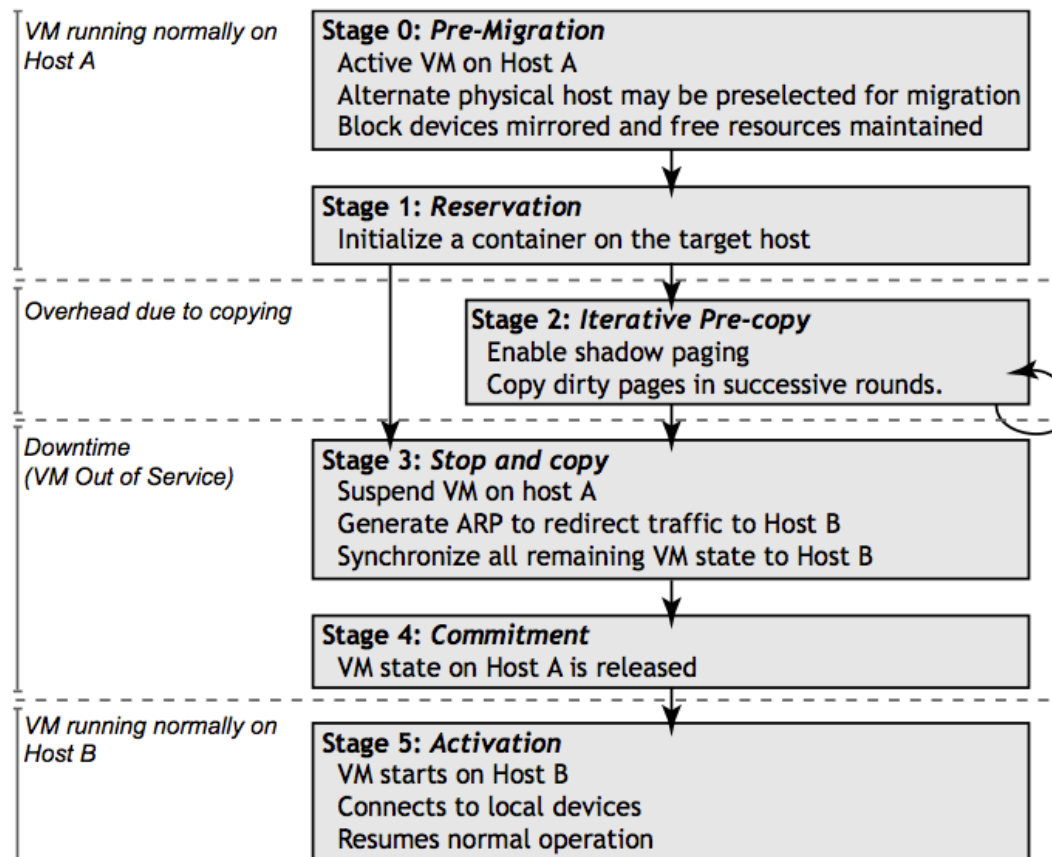

optimise resource utilisation and save power

VM Live Migration

It is important that this transfer occurs in a manner that balances the requirements of minimizing both downtime and total migration time
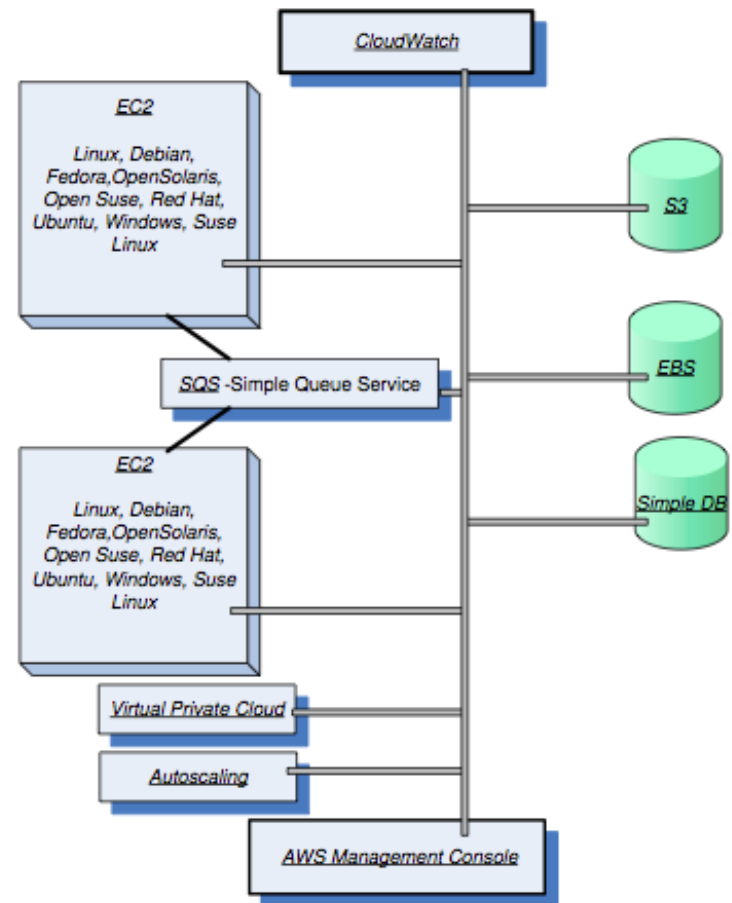
- **Push phase:** The source VM continues running while certain pages are pushed across the network to the new destination. To ensure consistency, pages modified during this process must be re-sent.

- **Stop-and-copy phase:** The source VM is stopped, pages are copied across to the destination VM, then the new VM is started.

- **Pull phase:** The new VM executes and, if it accesses a page that has not yet been copied, this page is faulted in ("pulled") across the network from the source VM.

VM Live Migration

VM running normally on Host A

Stage 0: *Pre-Migration*
Active VM on Host A
Alternate physical host may be preselected for migration
Block devices mirrored and free resources maintained

Stage 1: *Reservation*
Initialize a container on the target host

Overhead due to copying

Stage 2: *Iterative Pre-copy*
Enable shadow paging
Copy dirty pages in successive rounds.

Downtime (VM Out of Service)

Stage 3: *Stop and copy*
Suspend VM on host A
Generate ARP to redirect traffic to Host B
Synchronize all remaining VM state to Host B

Stage 4: *Commitment*
VM state on Host A is released

VM running normally on Host B

Stage 5: *Activation*
VM starts on Host B
Connects to local devices
Resumes normal operation

Cloud Infrastructure

- Amazon Web Service
  - Pioneer IaaS, 2000
  - Proprietary software stack

Cloud Architecture

- OpenStack
  - IaaS solution
  - Open Source Cloud Software Stack
    - Orchestration (Heat)
    - Dashboard (Horizon)
    - Networking (Neutron)
    - Block Storage (Cinder)
    - Compute (Nova)
    - Image Service (Glance)
    - Object Storage (Swift)
    - Telemetry (Ceilometer)
   - Identity Service (Keystone)
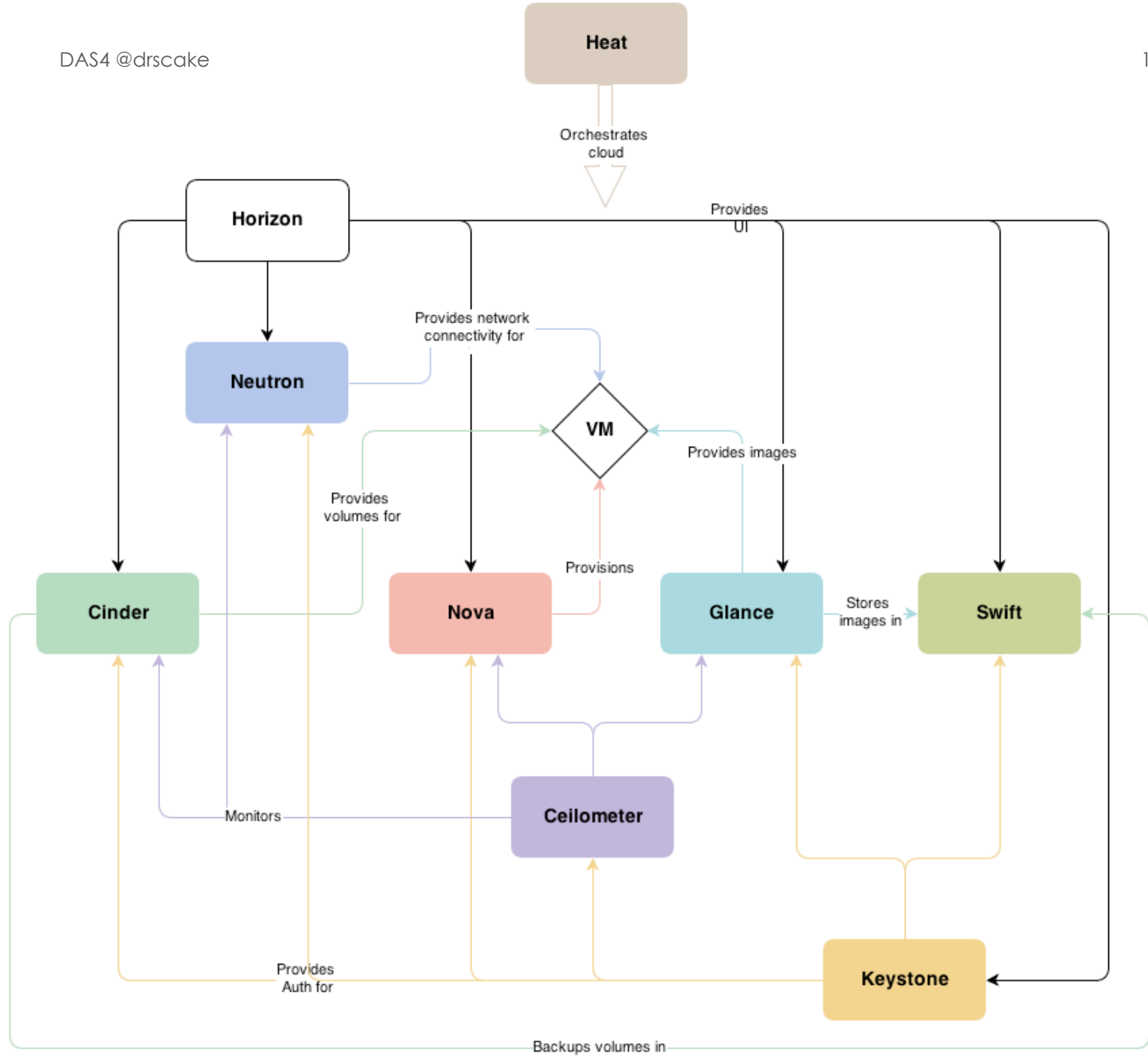
Cloud Applications

- Three broad categories:
  - Processing pipelines
    - Indexing; Data mining; Image processing; Video transcoding; Document processing
  - Batch processing systems
    - Generation of daily report; payroll; Inventory management
  - Web applications (increasingly important)
    - Elastic web services

Cloud Application – Architecture

- Client-server Paradigm
  - More robust
    - errors do not propagate
    - the clients and the servers are independent modules and may fail separately
  - More efficient
    - Front end server dispatches jobs to multiple back-end servers
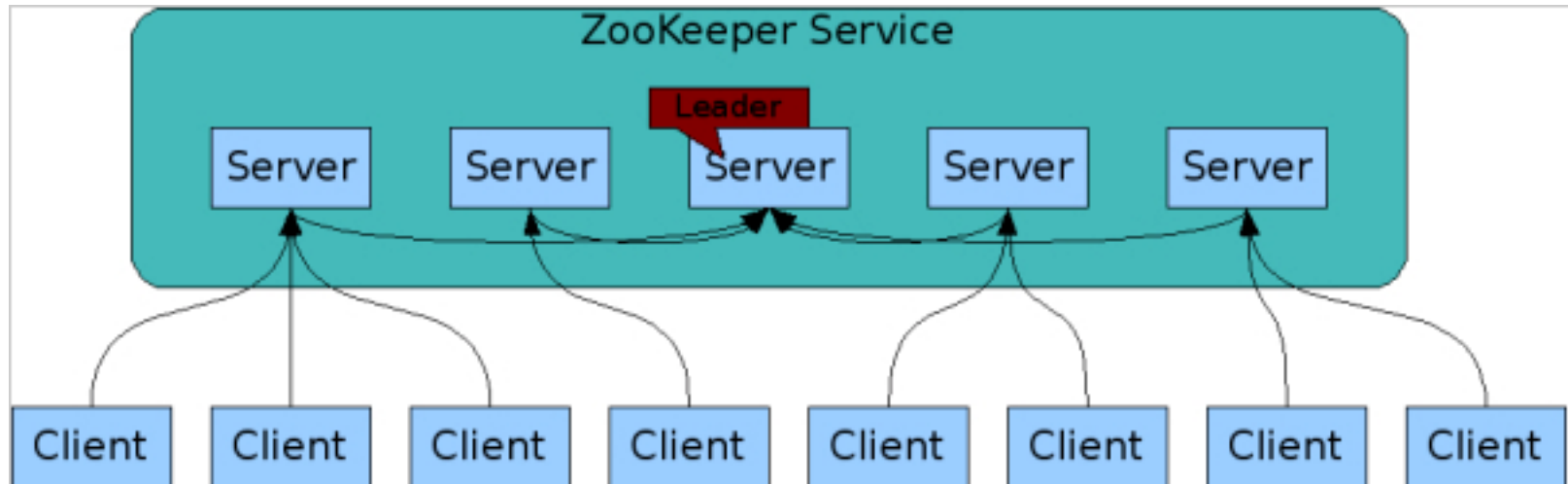   - Exploit elasticity of cloud computing

Cloud Application - Coordination

◘ Zookeeper: A Distributed Coordination Service for Distributed Applications

   ◘ Simple: distributed processes coordinate with each other through a shared hierarchal namespace which is organized similarly to a standard file system
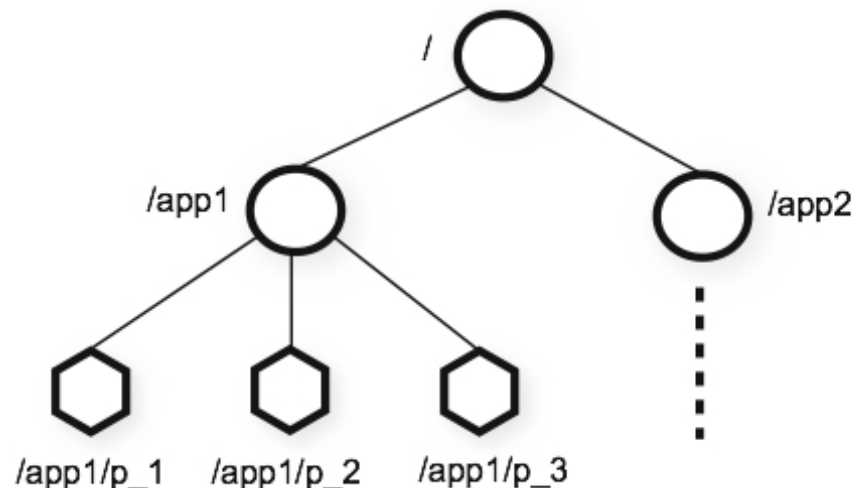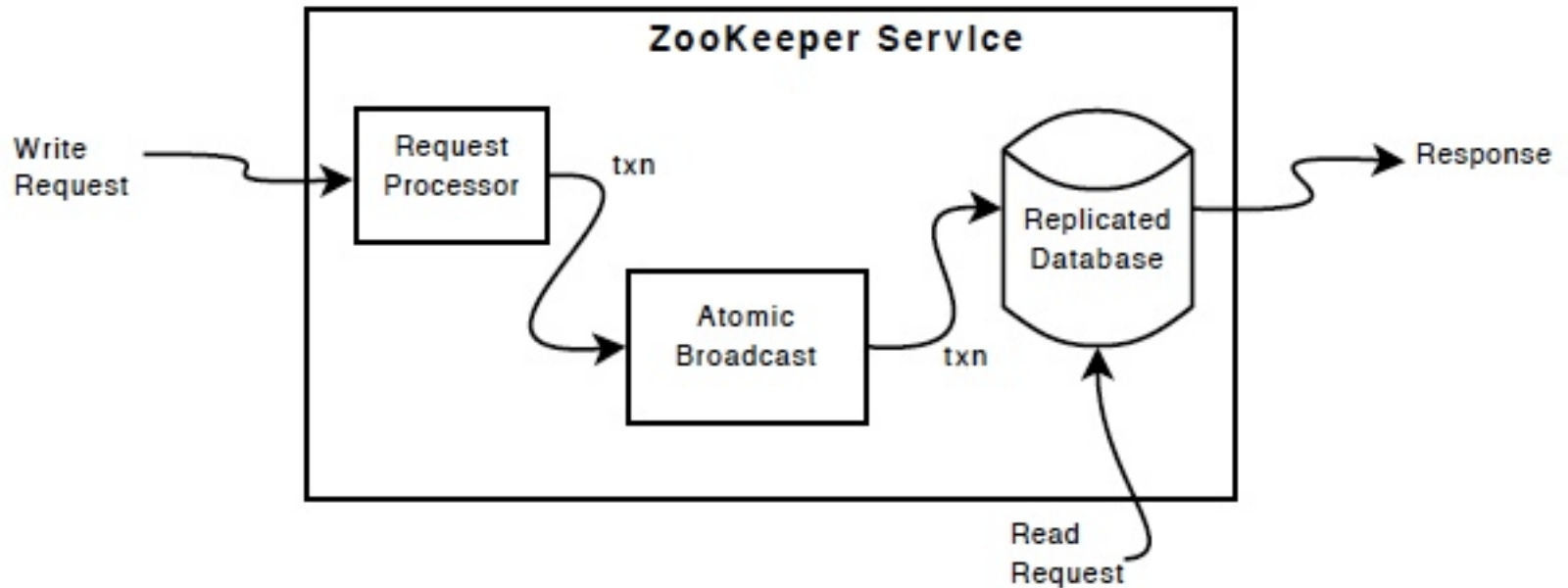
Cloud Application - Coordination

◼ Zookeeper: A Distributed Coordination Service for Distributed Applications

◼ Reliable: is replicated over a sets of hosts called an ensemble

Cloud Application - Coordination

◻ Zookeeper: A Distributed Coordination Service for Distributed Applications

Conclusion

- ◘ What is Cloud computing

- ◘ Cloud infrastructure

- ◘ Cloud applications & paradigms