

# Infrastructure as a Service (IaaS)

Hardware as a Service (HaaS).

One of the three fundamental service models of cloud computing alongside Platform as a Service (PaaS) and Software as a Service (SaaS)

IaaS is a **provision** model in which an organization **outsources** the equipment used to support operations, including **storage, hardware, servers and networking components.**

The service provider **owns** the equipment and is responsible for **housing, running and maintaining** it.

# **Providers**

- **Amazon Web Services:**
- **IBM**
- **Open source**
  - **OpenStack**
  - **Eucalyptus**
  - **OpenNebula**
  - **Nimbus**
  - **Enomaly**

# IaaS Research Questions

- What is the right distributed architecture for a cloud computing system?
- What resource characteristics must VM instance schedulers consider to make most efficient use of the resources?
- How do we construct VM instance networks that are flexible, well-performing, and secure?

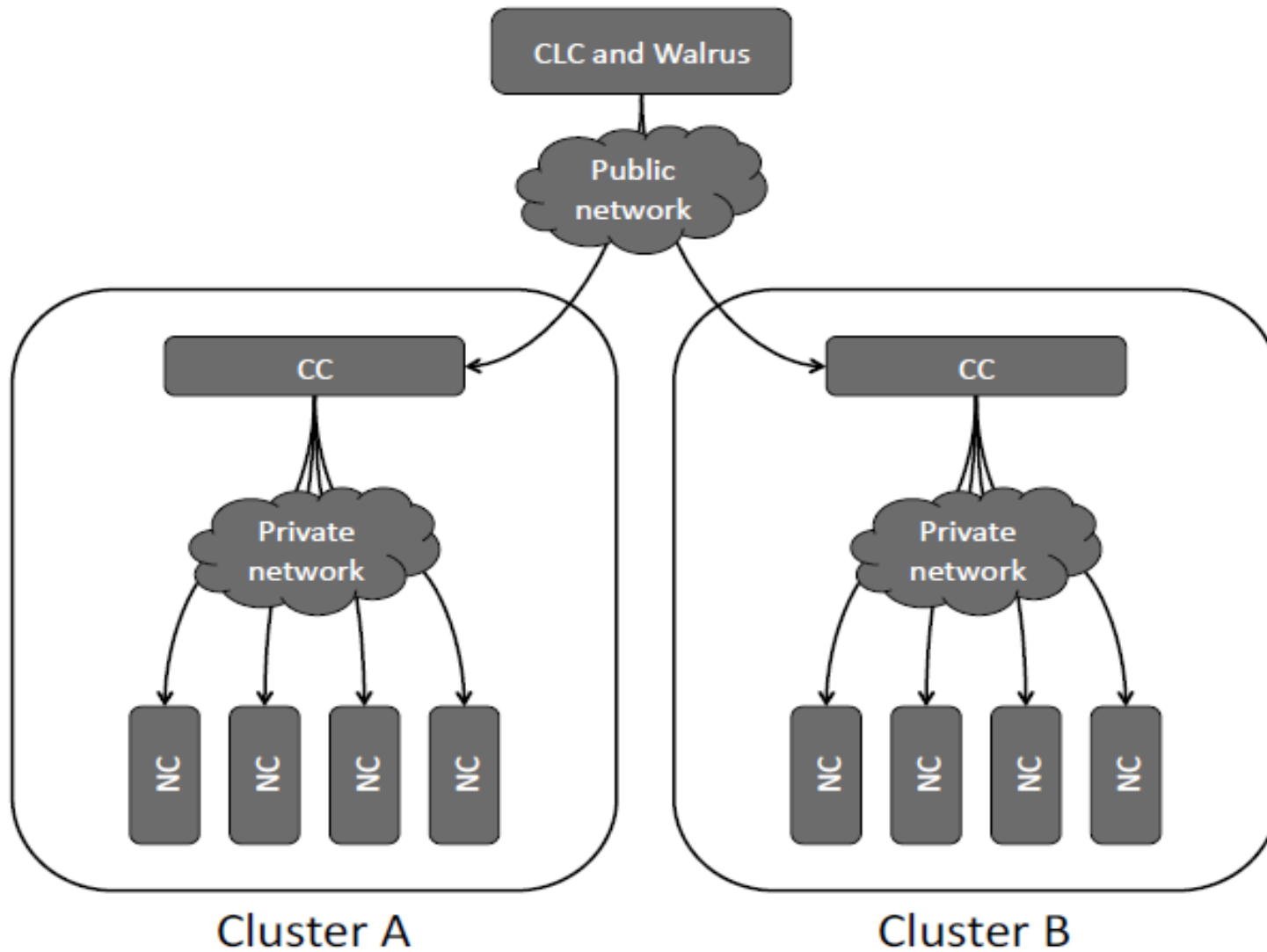
# Eucalyptus Open-source CC System

- Open source **software framework** for cloud computing that **implements** what is commonly referred to as Infrastructure as a Service (**IaaS**).
- Give users the ability to **run and control** entire **virtual machine** instances deployed across a variety physical resources

# Eucalyptus

- Implements a cloud computing “operating system” that is, by design, **hypervisor agnostic**.
- The current implementation of the system uses **Xen-based** virtualization as its initial target hypervisor.
- Allows users to start, control, access, and terminate entire virtual machines using an emulation of **Amazon EC2's** SOAP and “Query” interfaces.

# Eucalyptus Design





# Node Controller [NC]

- Executes on **every node** that is designated for hosting VM instances.
- An NC makes queries to discover the node's physical resources – the number of cores, the size of memory, the available disk space – as well as to learn about the state of VM instances on the node
- Upon verifying the authorization – e.g., only the owner of an instance or an administrator is allowed to terminate it – and after confirming resource availability, the NC executes the request with the assistance of the hypervisor.

# Node Controller [NC]

- **To start an instance,**
  - The NC makes a node-local copy of the instance image files (the kernel, the root file system, and the ramdisk image), either from a remote image repository or from the local cache,
  - Creates a new endpoint in the virtual network overlay, and
  - Instructs the hypervisor to boot the instance.
- **To stop an instance,**
  - The NC instructs the hypervisor to terminate the VM,
  - Tears down the virtual network endpoint, and
  - Cleans up the files associated with the instance (the root file system is not preserved after the instance terminates).

# Cluster Controller

- Executes on a **cluster front-end machine**, or any machine that has network connectivity to both the nodes running NCs and to the machine running the Cloud Controller (CLC).
- Many of the CC's operations are similar to the NC's operations but are generally **plural** instead of singular (e.g. runInstances, describeInstances, terminateInstances, describeResources).
- **CC has three primary functions:**
  - Schedule incoming instance run requests to specific NCs,
  - control the instance virtual network overlay, and
  - gather/report information about a set of NCs.

# Cluster Controller

- **When a CC receives a set of instances to run,**
  - it contacts each NC component through its describeResource operation and
  - sends the runInstances request to the first NC that has enough free resources to host the instance.
- **When a CC receives a describeResources request,**
  - it also receives a list of resource characteristics (cores, memory, and disk) describing the resource requirements needed by an instance (termed a VM “type”).
  - With this information, the CC calculates how many simultaneous instances of the specific “type” can execute on its collection of NCs and reports that number back to the CLC.

# Storage Controller (Walrus)

- A data storage service
- Walrus provides two types of functionality.
  - Users that have access to EUCALYPTUS can use Walrus to stream data into/out of the cloud as well as from instances that they have started on nodes.
  - Walrus acts as a storage service for VM images. Root file system as well as kernel and ramdisk images used to instantiate VMs on nodes

# Cloud Controller

- A collection of web services
- Grouped by their roles into three categories:
- **Resource Services**
  - perform system-wide arbitration of resource allocations,
  - let users manipulate properties of the virtual machines and networks,
- **Data Services**
  - Govern persistent user and system data
  - and provide for a configurable user environment for formulating resource allocation request properties.
- **Interface Services**
  - present user-visible interfaces,
  - handling authentication & protocol translation, and
  - expose system management tools providing.

# Virtual Network Overlay

- VM instance interconnectivity
- Every virtual machine that EUCALYPTUS controls must have network connectivity to each other, and at least partially to the public Internet (we use the word “partially” to denote that at least one VM instance in a “set” of instances must be exposed externally so that the instance set owner can log in and interact with their instances).

- Users are granted super-user access to their provisioned VMs, ...security concerns,
  - A VM instance user may have the ability to acquire system IP or MAC addresses
  - Cause interference on the system network .
  - Interference another VM that is co-allocated on the same physical resource
- VMs belonging to a single cloud allocation must be able to communicate, but VMs belonging to separate allocations must be isolated.
- Eucalyptus attempts to maintain inter-VM network performance as close to native as possible.
- The CC currently handles the set up and tear down of instance virtual network interfaces in three distinct, administrator defined “modes”, corresponding



# **Reference**

- The Eucalyptus Open-source Cloud-computing System