

CLOUD COMPUTING



Outline

- Definitions of Cloud computing
- Architecture of Cloud computing
- Benefits of Cloud computing
- Opportunities of Cloud Computing
- Cloud computing – Google Apps
- Grid computing vs Cloud computing

Definitions

- Cloud computing is using the internet to access someone else's software running on someone else's hardware in someone else's data center.

Definitions

- A large-scale **distributed computing paradigm** that is driven by economies of scale, in which **a pool of abstracted, virtualized, dynamically scalable, managed computing power, storage, platforms, and services** are delivered on demand to external customers over the Internet.

Definitions

- A Cloud is a type of parallel and distributed system consisting of a collection of interconnected and virtualized computers that are dynamically provisioned and presented as one or more unified computing resources based on service-level agreements established through negotiation between the service provider and consumers.

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Architecture

- Cloud Service Models
- Cloud Deployment Models
- Essential Characteristics of Cloud Computing

Architecture

Broad
Network Access

Rapid Elasticity

Measured Service

On-Demand
Self-Service

Resource Pooling

**Essential
Characteristics**

Software as a
Service (SaaS)

Platform as a
Service (PaaS)

Infrastructure as a
Service (IaaS)

**Service
Models**

Public

Private

Hybrid

Community

**Deployment
Models**

NIST Visual Model of Cloud Computing Definition

A. Seetharam Nagesh,
Sr. Asst. Professor, CVRCE

Essential Characteristics^[7]

- On-demand self-service.
 - A consumer can unilaterally provision computing capabilities such as server time and network storage as needed automatically, without requiring human interaction with a service provider.

Essential Characteristics^[7]

- Broad network access.
 - Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, laptops, and PDAs) as well as other traditional or cloudbased software services.

Essential Characteristics^[7]

- Resource pooling.
 - The provider's computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand.

Essential Characteristics^[7]

- **Rapid elasticity.**

- Capabilities can be rapidly and elastically provisioned - in some cases automatically - to quickly scale out; and rapidly released to quickly scale in.
- To the consumer, the capabilities available for provisioning often appear to be unlimited and can be purchased in any quantity at any time.

Essential Characteristics^[7]

- **Measured service.**

- Cloud systems automatically control and optimize resource usage by leveraging a metering capability at some level of abstraction appropriate to the type of service.
- Resource usage can be monitored, controlled, and reported - providing transparency for both the provider and consumer of the service.

Cloud Service Models

SPI Model

- Cloud **S**oftware as a Service (**SaaS**)
- Cloud **P**latform as a Service (**PaaS**)
- Cloud **I**nfrastructure as a Service (**IaaS**)

Infrastructure as a Service (IaaS)

- The capability provided to the consumer is to provision processing, storage, networks, and other fundamental computing resources.
- Consumer is able to deploy and run arbitrary software, which can include operating systems and applications.
- The consumer does not manage or control the underlying cloud infrastructure but has control over operating systems, storage, deployed applications, and possibly limited control of select networking components (e.g., host firewalls).

Platform as a Service (PaaS)

- The capability provided to **the consumer is to deploy onto the cloud infrastructure consumer created or acquired applications** created using programming languages and tools supported by the provider.
- The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, or storage, but has control over the deployed applications and possibly application hosting environment configurations.

Software as a Service (SaaS)

- The capability provided to the consumer is to use the provider's applications running on a cloud infrastructure.
- The applications are accessible from various client devices through a thin client interface such as a web browser (e.g., web-based email).
- The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, storage, or even individual application capabilities, with the possible exception of limited user specific application configuration settings.

Cloud Deployment Models

- Public Cloud.
- Private Cloud.
- Community Cloud.
- Hybrid Cloud.

Public Cloud

- The cloud infrastructure is made available to the general public or a large industry group and is owned by an organization selling cloud services.

Private Cloud

- The cloud infrastructure is operated solely for a single organization. It may be managed by the organization or a third party, and may exist on-premises or off-premises.

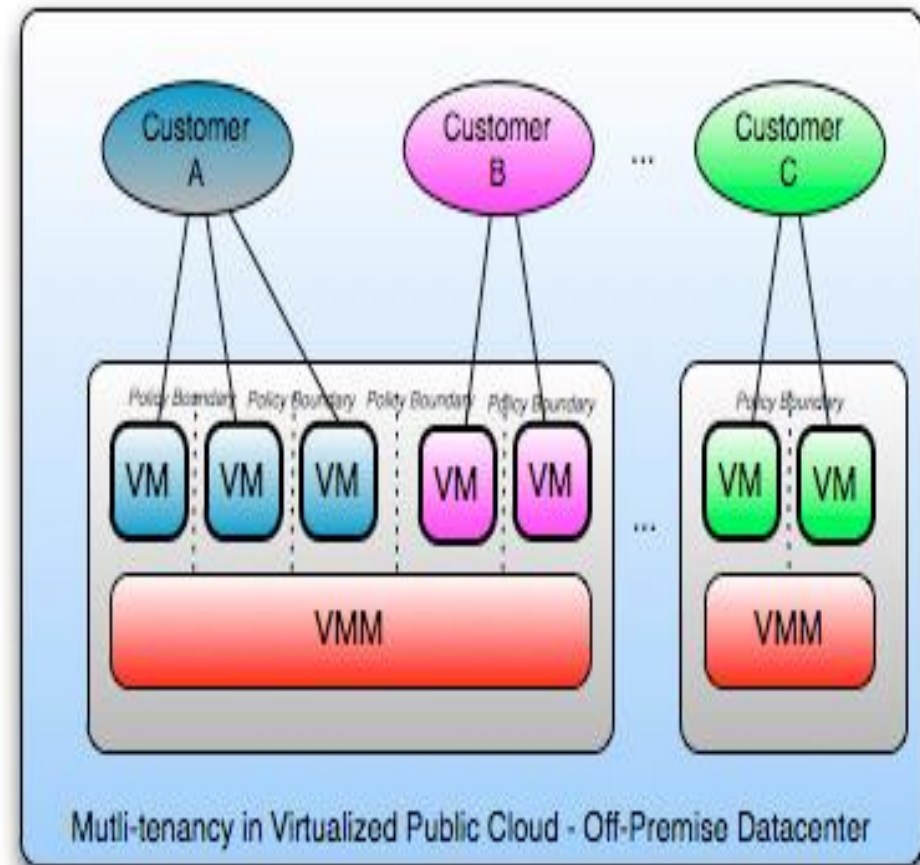
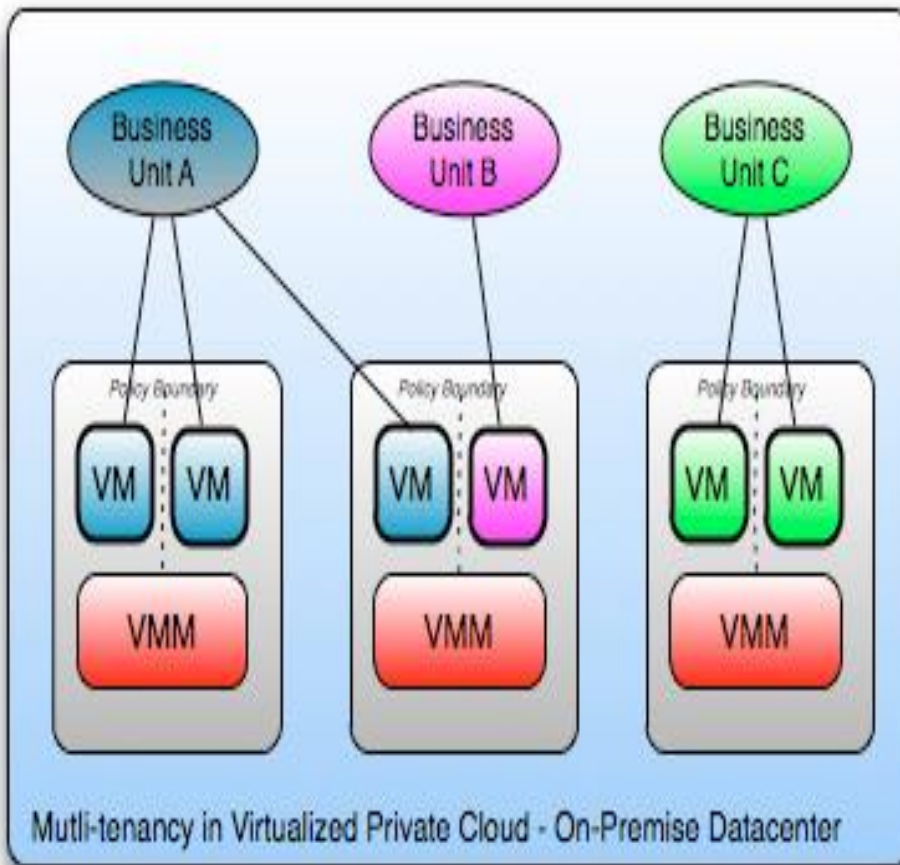
Community Cloud

- The cloud infrastructure is shared by several organizations and supports a specific community that has shared concerns (e.g., mission, security requirements, policy, or compliance considerations). It may be managed by the organizations or a third party and may exist on-premises or off-premises.

Hybrid Cloud

- The cloud infrastructure is a composition of two or more clouds (private, community, or public) that remain unique entities but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load-balancing between clouds).

Private VS Public Cloud



Private Cloud of Company XYZ with 3 business units, each with different security, SLA, governance and chargeback policies on shared infrastructure

Public Cloud Provider with 3 business customers, each with different security, SLA, governance and billing policies on shared infrastructure

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Benefits of Cloud Computing

- Business Benefits of Cloud Computing
- Technical Benefits of Cloud Computing

Business Benefits

- Almost zero upfront infrastructure investment
- Just-in-time Infrastructure
- More efficient resource utilization
- Usage-based costing
- Reduced time to market

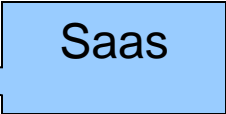
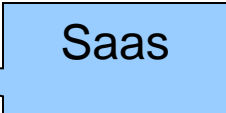
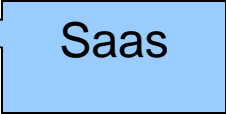
Technical Benefits

- Automation – “Scriptable infrastructure”
- Auto-scaling
- Proactive Scaling
- More Efficient Development lifecycle
- Improved Testability
- Disaster Recovery and Business Continuity

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Opportunities of Cloud Computing

- End consumers. 
- Business customers. 
- Developers and Independent Software Vendors (ISVs). 

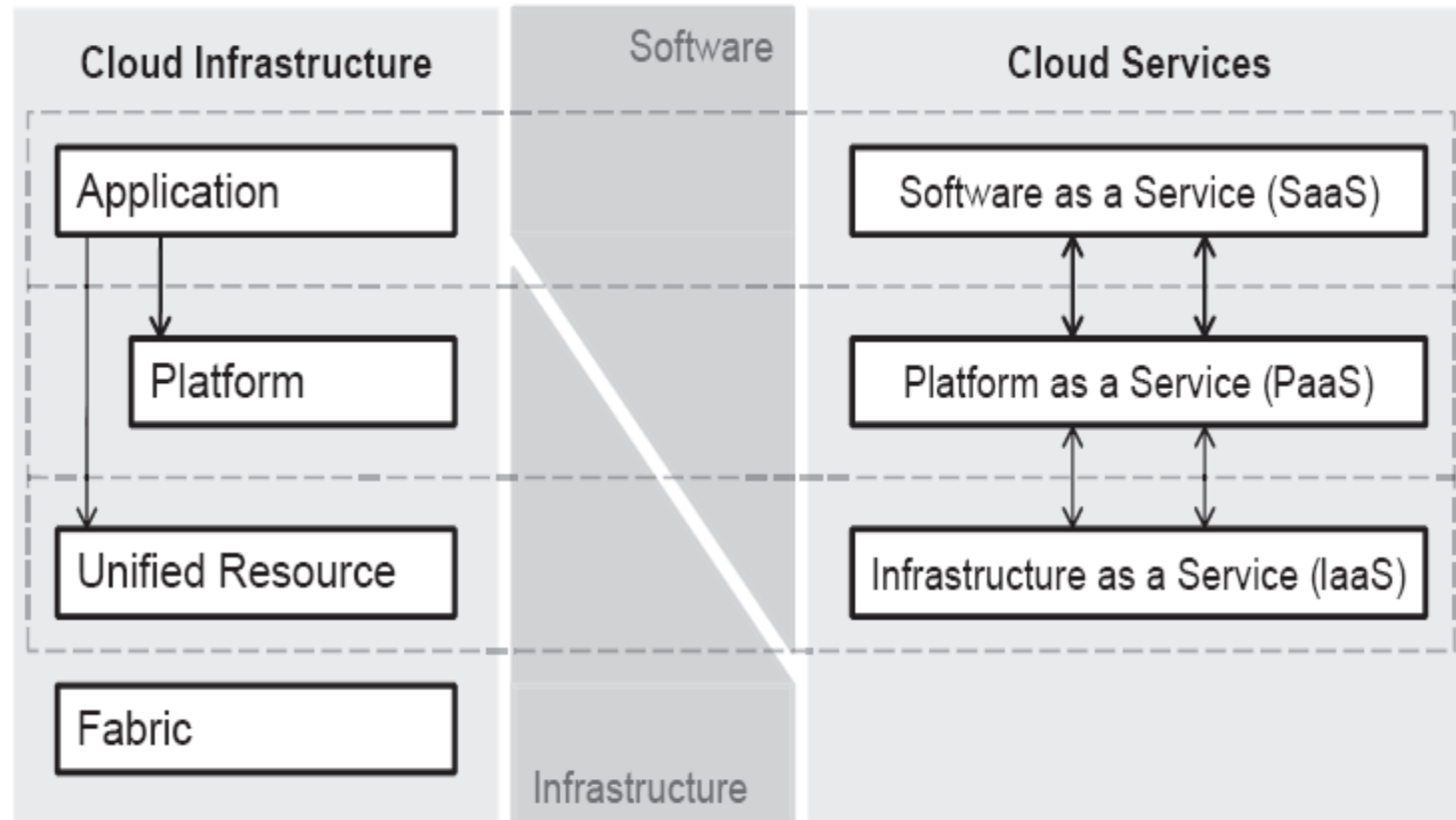
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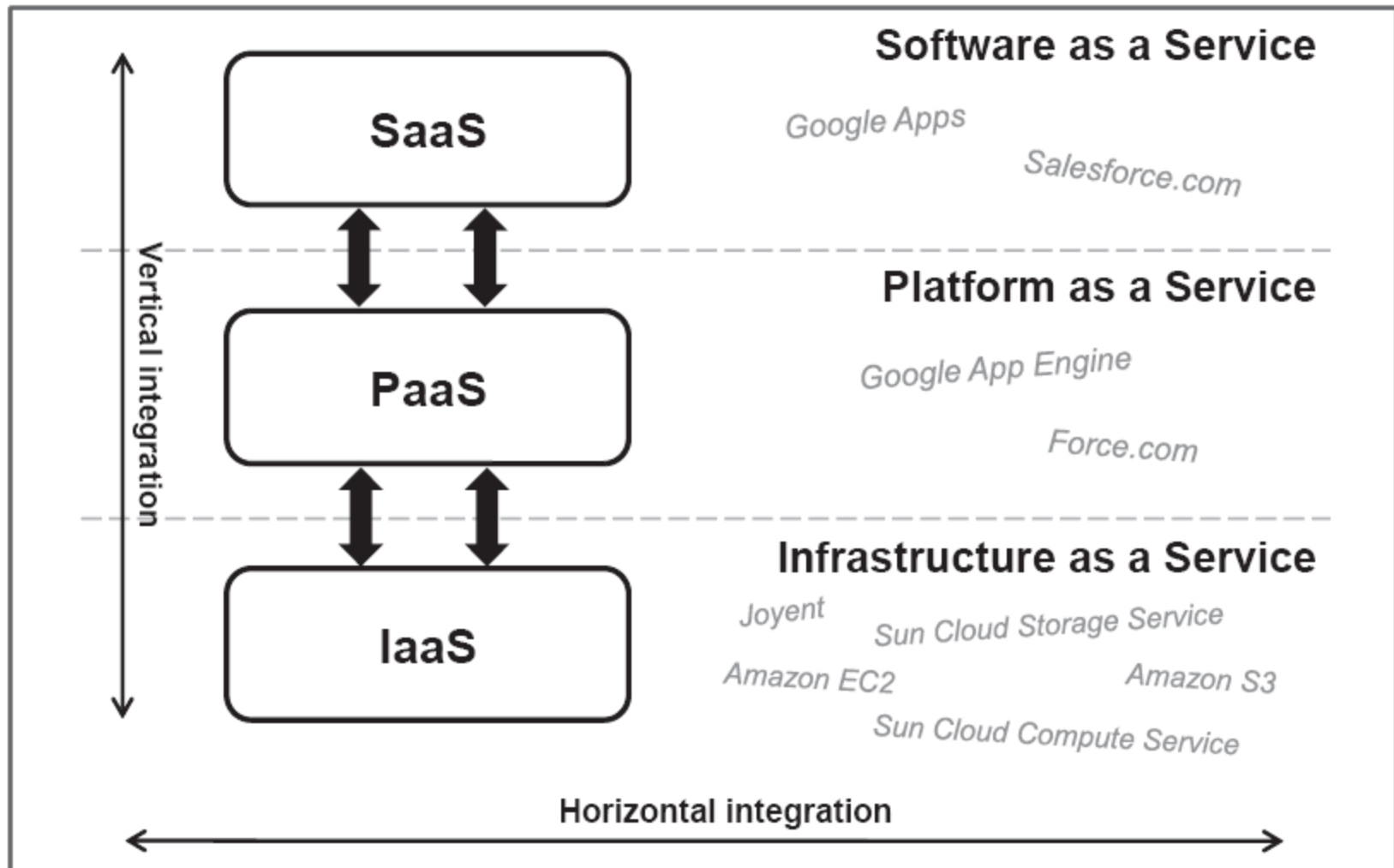
Cloud computing – Google Apps

- Email, chat.
- **Google App Engine**

Google App Engine



Google App Engine



Google App Engine

- Google App Engine?
- Create application.

Google App Engine?

- Google App Engine enables you to build web applications on the same scalable systems that power Google applications. App Engine applications are **easy to build**, **easy to maintain**, and **easy to scale** as your traffic and data storage needs grow.

Easy to build →
Write local,
upload server

Easy to scale →
how many user,
how much data

easy to maintain → 10
year (data & application)

Google App Engine?

- Cost ➔ ?
 - Pay only for what you actually use.
 - Exceed the free quota of 500 MB of storage and around 5M pageviews per month.
 - Trial? ➔ 1GB store & 5M pageviews

Create application

- build an App Engine application using standard Java web technologies, such as servlets and JSP.
- create an App Engine Java project with Eclipse → use the Google Plugin for Eclipse for App Engine development. (Use SDK)
- use the App Engine datastore with the Java Data Objects (JDO) standard interface.
- upload your app to App Engine.

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Grid computing vs Cloud computing

- Same
- Difference

same

- Increase computing.
- Increase store.

difference

- Business model
- Architecture
- Application.

Business model

- Cloud → consumption basis.
- Grid → project-oriented

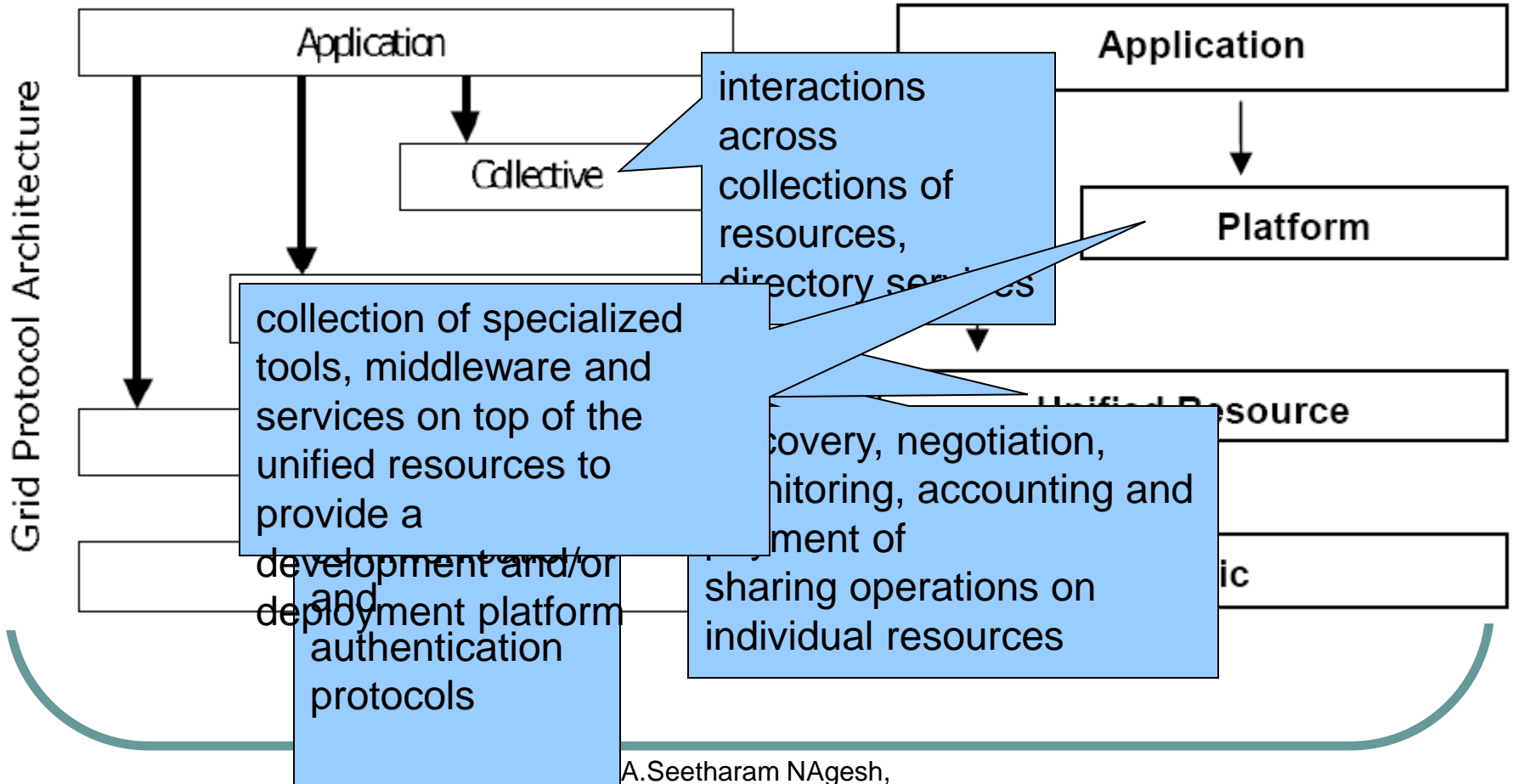
Grid → academia
or government labs

TeraGrid : number
of service units

Cloud → IBM,
Google, Microsoft ...

Hour, storage,
view...

Architecture



Application

- Grid Computing emerged in eScience to solve scientific problems requiring HPC.
- Cloud Computing is rather oriented towards applications that run permanently and have varying demand for physical resources while running.
 - the well-known CRM SaaS Salesforce.com.