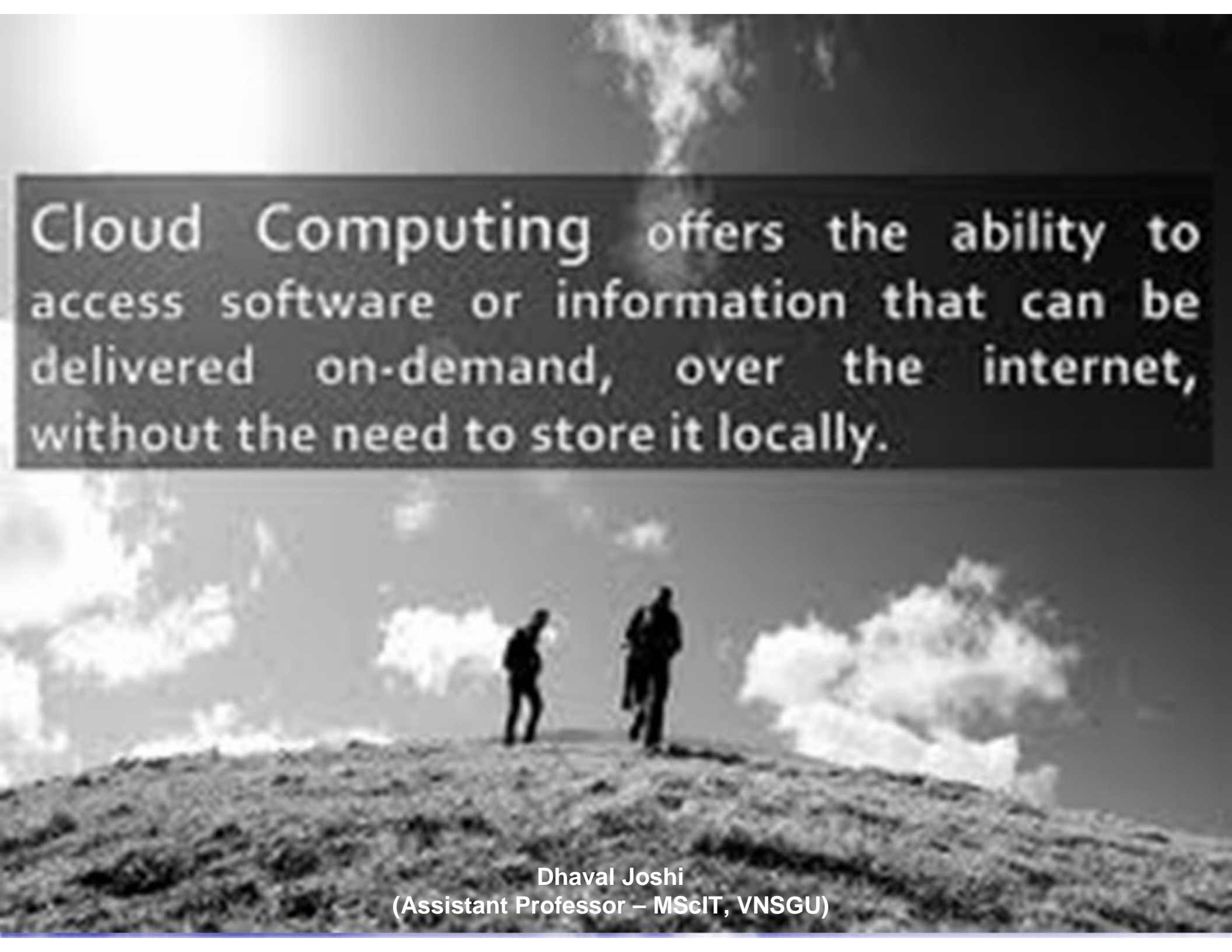# Introduction to Cloud Computing

By
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Cloud Computing offers the ability to access software or information that can be delivered on-demand, over the internet, without the need to store it locally.

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Cloud computing

- Cloud computing is the realization of the long-held dream of utility computing.

- The "Cloud" is a metaphor for the Internet, derived from a common representation in computer network drawings showing the Internet as a cloud.

Utility computing

- A concept that entails having access to computing resources.

- Paying for the use of those resources on a metered basis.
  - similar to paying for common utilities such as
    - Water Service
    - Electricity Service
    - Telephone service

Cloud Computing came from

- Time-sharing system
- Mainframe computing system
- Transactional computing system
- Grid Computing system

Characteristics of Cloud Computing

- The illusion of infinite resources

- Multi-tenancy (Shared resource)

- Scale on demand (Scalability)

- Elasticity

- Self-provisioning of resources

- Pay-for-play (Pay as you use/go)

- High availability and an SLA (Service Level Agreement)

- Geographically distributed data centers

Characteristics of Cloud Computing

- ## The illusion of infinite resources
  - Illusion of computing and storage resources.
  - User do not require capacity planning and provisioning for own individual storage and computing infrastructure.

Characteristics of Cloud Computing

- **Multi-tenancy (Shared resource)**
  - Cloud computing is based on a business model in which resources are shared at
    - Network Level
    - Host Level
    - Application Level
  - Multiple users use the same resource.

Characteristics of Cloud Computing

- **Scale on demand (Scalability)**
  - Ability to scale to tens of thousands of systems.
  - Ability to massively scale bandwidth and storage space.
  - Batter than lengthy sales-and-provisioning process.

Characteristics of Cloud Computing

- **Elasticity**
  - Rapidly increase and decrease users' computing resources as needed.
  - Release resources for other uses when they are no longer required.

Characteristics of Cloud Computing

- **Self-provisioning of resources**
  - Users can self-provision for additional resources like
    - Processing capability
    - Software
    - Storage
    - Network

Characteristics of Cloud Computing

- **Pay-for-play (Pay as you use/go)**
  - Pay only for what you use.
  - Do not require any upfront investment, reservation or major setup fees.
  - Do not incur huge capital expenditure (capex) and operating expenditure (opex).

Characteristics of Cloud Computing

- **High availability and an SLA (Service Level Agreement)**
  - Guarantee for 24 x 7 availability
  - Most cloud providers have a SLA for uptime and refund mechanism if SLA isn't meet.
    - e.g. Windows Azure provides an SLA for both its storage and its hosting pieces.

Characteristics of Cloud Computing

- **Geographically distributed data centers**
  - To serve customers around the globe, data centers are at multiple geographical locations.
  - This require because of
    - Legal/regulatory concerns
    - Geopolitical considerations
    - Load balancing
    - Network latency
    - Edge caching
    - and many more...

Cloud Services

- **Infrastructure as a service (IaaS)**

- **Platform as a service (PaaS)**

- **Software as a service (SaaS)**

"IaaS"
Infrastructure-as-a-Service
host

"PaaS"
Platform-as-a-Service
build

"SaaS"
Software-as-a-Service
consume

Infrastructure as a service (IaaS)

- The IaaS model is similar to utility computing. Means you pay for what you consume.

- IaaS refers to online services that abstract the user from the details of infrastructure.
  - Physical computing resources, location, data partitioning, scaling, security, backup, etc.

- The provider is in complete control of the infrastructure.

- Typical IaaS system features are:
  - Scalability, Pay as you go, Best-of-breed technology and resources

Platform as a service (PaaS)

- PaaS Vendor offers a development environment to application developers.

- The provider typically develops toolkits and standards for development, and channels for distribution and payment.

- The provider receives a payment for providing the platform and the sales and distribution services.

- Developers can build web applications without installing any tools on their computer, and can deploy those applications without any specialized administrator skills.

Software as a service (SaaS)

- Customer dose not purchase software, but rents it for use on a subscription bases or pay-per-use model.

- The service is complete from a hardware, software and support perspective.

- User can access service through any authorized device.

- Integration service(s) with other application which are not part of SaaS, need to be managed and taken care by customer.

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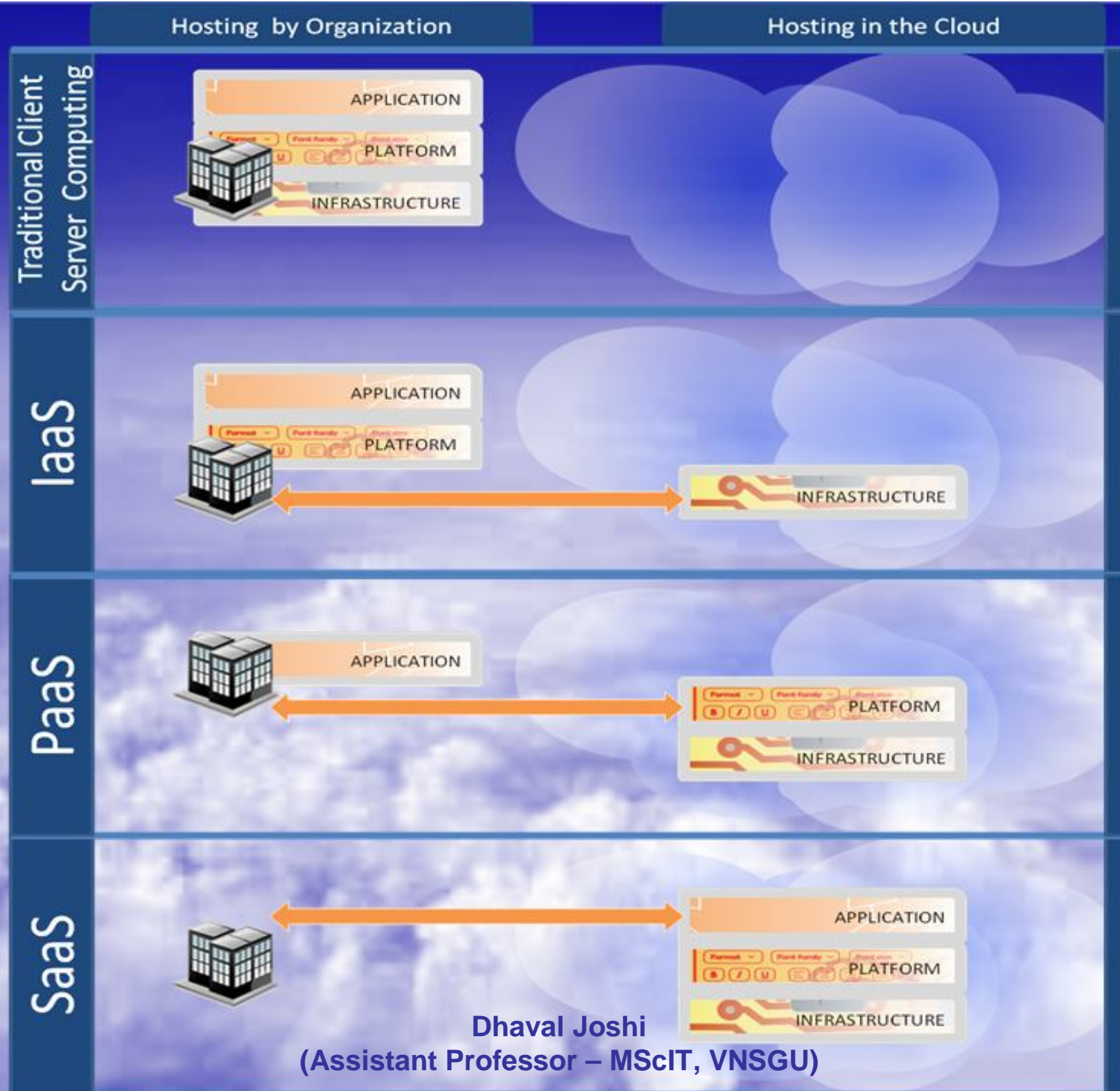
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More classifications of Cloud Computing by CSPs

- Storage-as-a-service
- Database-as-a-service
- Information-as-a-service
- Process-as-a-service
- Application-as-a-service
- Platform-as-a-service
- Integration-as-a-service
- Security-as-a-service
- Management/Governance-as-a-service
- Testing-as-a-service
- Infrastructure-as-a-service

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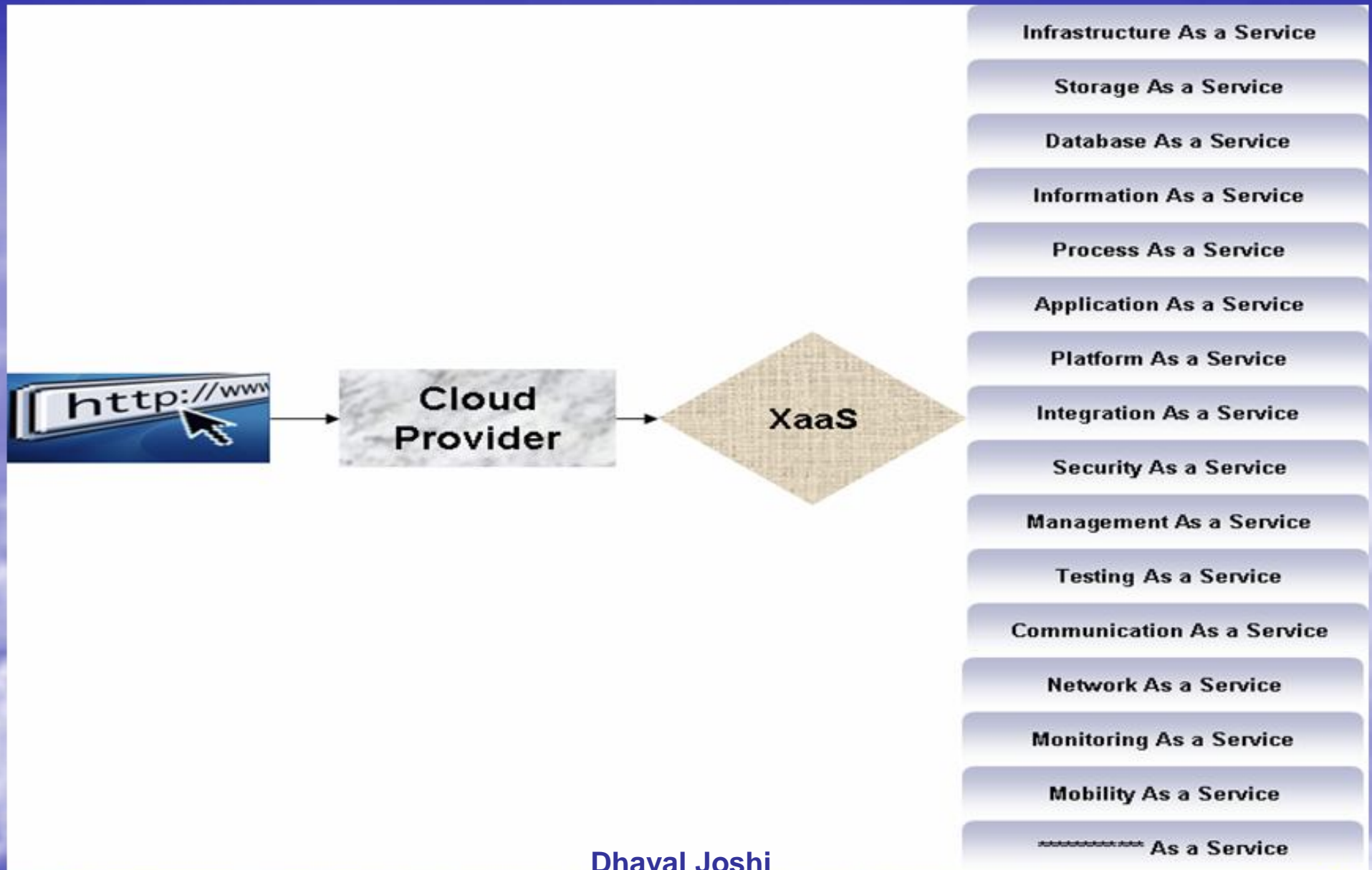
XaaS

XaaS

- **Storage as a Service** – The ability to leverage storage that physically exists remotely, but is logically a local storage resource to any application that requires storage.

- **Database as a Service** – The ability to leverage the services of a remotely hosted database, sharing it with other users, and having it logically function as if the database were local.

XaaS

- **Information as a Service** – The ability to consume any type of information, remotely hosted, through a well-defined interface such as an API.

- **Process as a Service** – A remote resource that's able to bind many resources together, either hosted within the same cloud computing resource or remote, to create business processes.

XaaS

- **Integration as a Service** – The ability to deliver a complete integration stack from the cloud, including interfacing with applications, semantic mediation, flow control, and integration design.

- **Security as a Service** - The ability to deliver core security services remotely over the Internet.

XaaS

- **Management/Governance as a Service** - Any on-demand service that provides the ability to manage one or more cloud services, typically simple things such as topology, resource utilization, virtualization, and uptime management.

- **Testing as a Service** – The ability to test local or cloud-delivered systems using testing software and services that are remotely hosted.

XaaS

- **Communications as a service (Hosted Communications)**

- **Network as a service (NaaS)**

- **Monitoring as a service (MaaS)**

- **Mobility-as-a-Service (MaaS)**

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Recent notable cloud launches

	Desktop and Business Applications
Cloud Applications	ZOHO Google
	Software platform to host cloud-based enterprise applications
Cloud Software Development Platform	Windows Azure Google salesforce.com
	Servers, Storage, Security, Database
Cloud-based Infrastructure	rackspace Sun microsystems amazon.com IBM

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Cloud Deployment Models

- **Private Cloud**
- **Community Cloud**
- **Public Cloud**
- **Hybrid Cloud**

PRIVATE CLOUD   COMMUNITY CLOUD   PUBLIC CLOUD

Hybrid Cloud

PRIVATE CLOUD

COMMUNITY CLOUD

PUBLIC CLOUD

Private Cloud   Community Cloud   Public Cloud   28
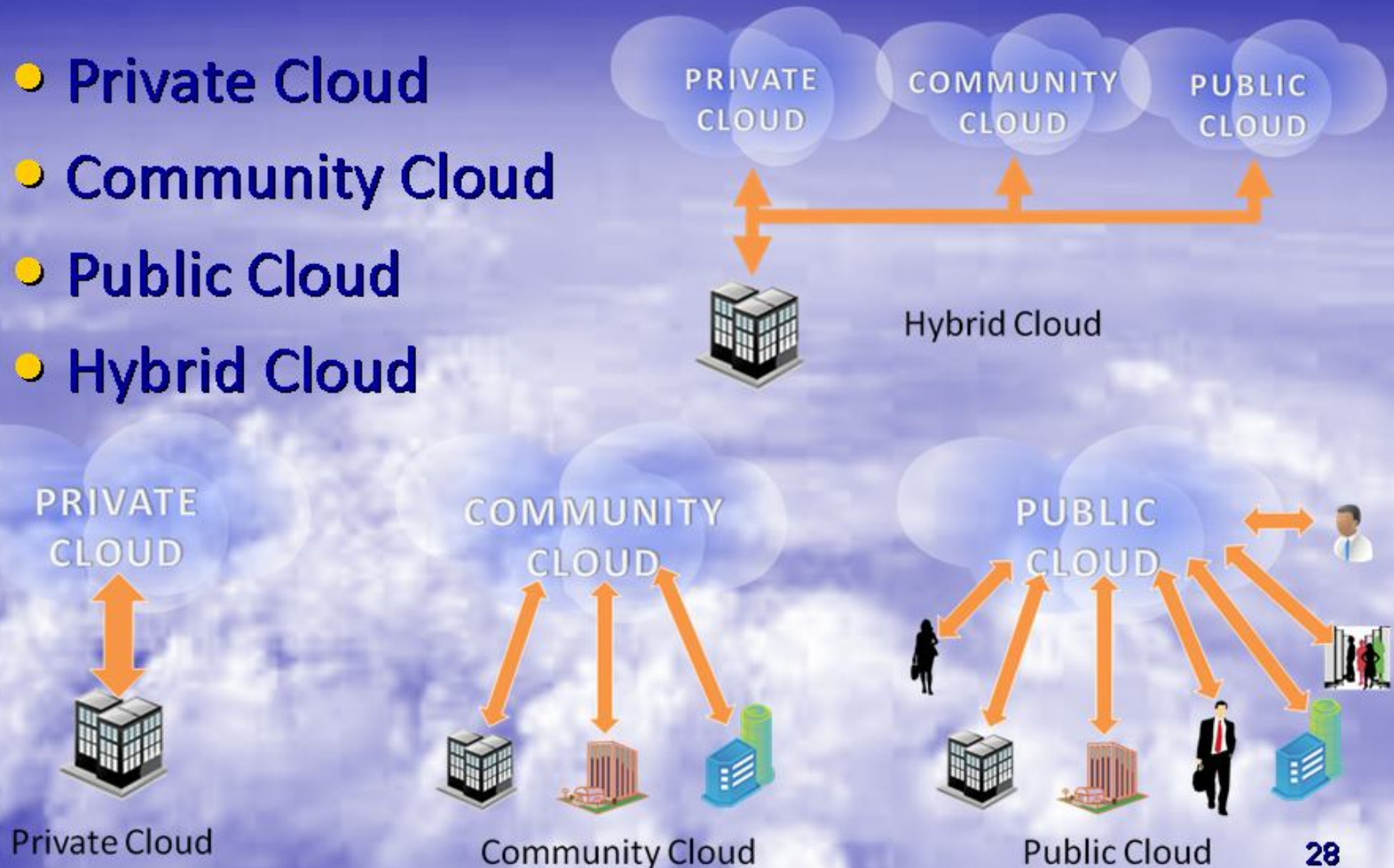
Private Cloud

- Also known as "internal cloud".
- It used to describe offerings that emulate cloud computing on private network.
- Organizations must buy, build and manage them.
- Doesn't give benefit of lower upfront capex.

Community Cloud

- Shares infrastructure between several organizations from a specific community with common concerns
  - (security, compliance, jurisdiction, etc.)
- Infrastructure is managed internally or by a third-party and hosted internally or externally.
- The costs are spread over fewer users than a public cloud (but more than a private cloud), so only some of the benefits of cloud computing are realized.

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Public Cloud

- Also known as "external cloud".

- Describes cloud computing in the traditional mainstream where resources are dynamically provisioned on a fine-grained, self-service basis over the Internet.

- Web applications or web services are used to do so.

- Public cloud is hosted, operated and managed by a third-party vendor from one or more data centers.

- The service is offered to multiple customers over a common infrastructure.

Public Cloud

- Security management and day-to-day operations are relegated to the third-party vendors.

- Customer has a low degree of control over cloud.

Hybrid Cloud

- A Hybrid cloud environment consisting of multiple internal and/or external providers is a possible deployment for organizations.

- Organizations might run non-core applications in a public cloud, while maintaining core application and sensitive data in-house (private cloud).

Phased Evolution of Cloud

Phase 1	Phase 2	Phase 3	Phase 4
	Private Clouds	Private Clouds	Inter-Cloud

Stand-Alone Data Centers

Virtual Private Cloud

Inter-Cloud

Public Cloud | Public Cloud | Public Cloud #1 | Public Cloud #2

Federation / Workload Portability / Interoperability
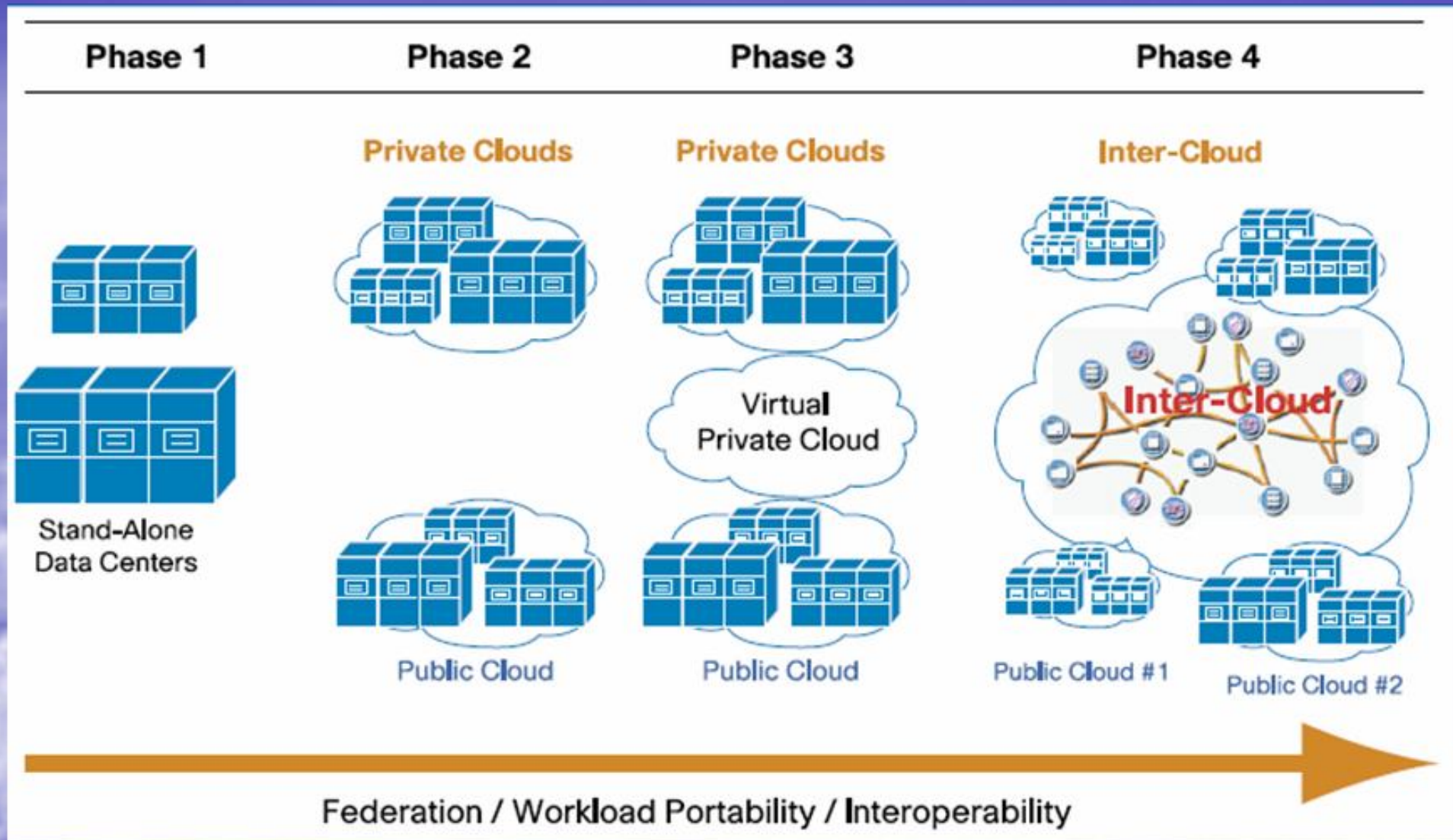
Inter-connected Cloud

Inter-connected Cloud

Cloud Taxonomy
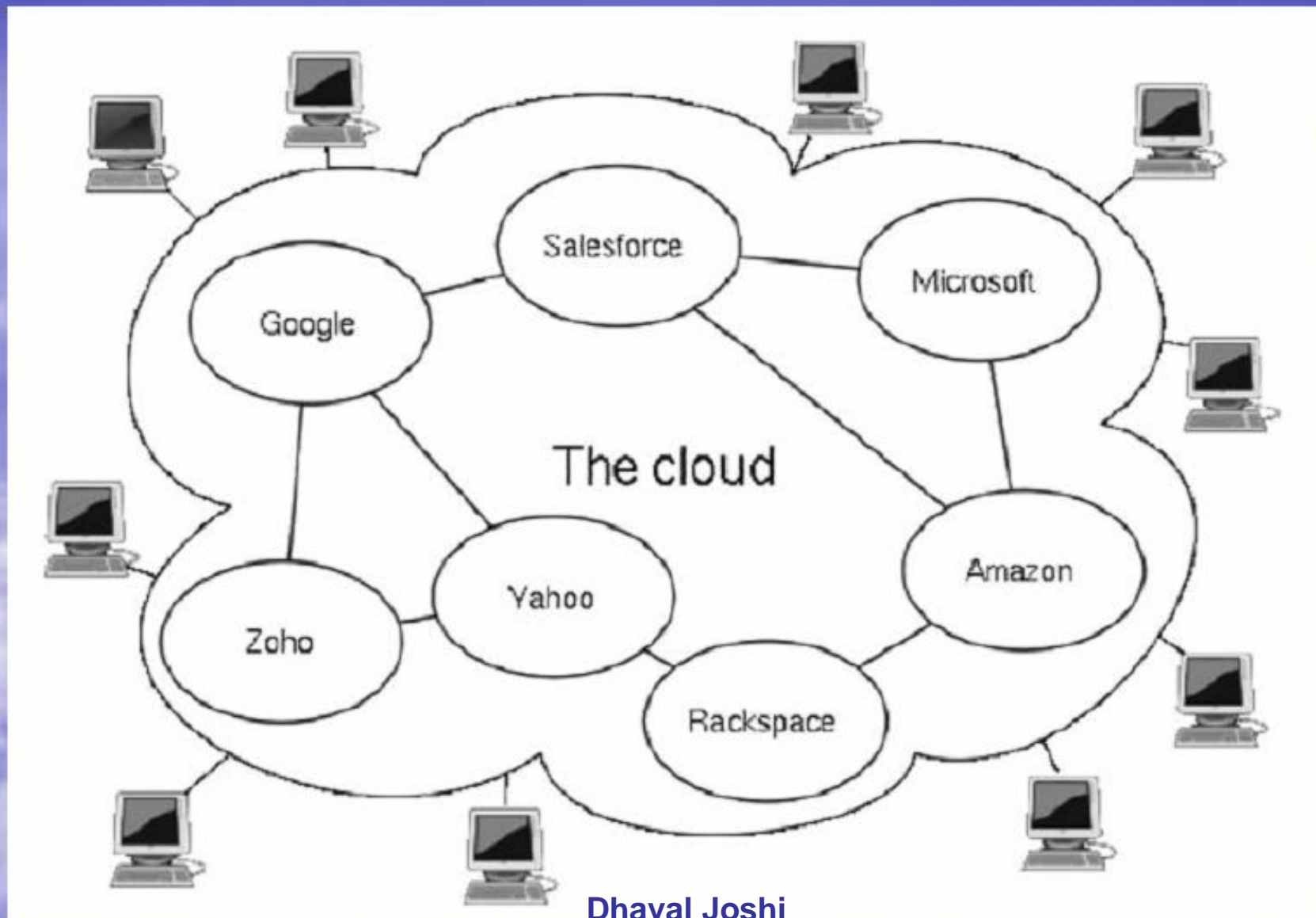
Infrastructure Services

Storage
- Amazon S3
- Amazon EBS
- CTERA Portal
- Mosso Cloud Files
- Nirvanix

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

Services Management
- RightScale
- enStratus
- Scalr
- CohesiveFT
- Kaavo
- CloudStatus
- Ylastic
- Dynect
- CloudFoundry
- NewRelic
- Cloud42

Cloud Software

Data
- 10Gen MongoDB
- Oracle Coherence
- Gemstone Gemfire
- Apache CouchDb
- Apache HBase
- Hypertable
- TerraCotta
- Tokyo Cabinet
- Cassandra
- memcached

Appliances
- PingIdentity
- Symplified
- rPath
- Vordel

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

File Storage
- EMC Atmos
- ParaScale
- Zmamda
- CTERA

Cloud Management
- 3Tera App Logic
- OpenNebula
- Open.ControlTier
- Enomaly Enomalism
- Altor Networks
- VMware vSphere
- OnPathTech
- CohesiveFT VPN Cubed
- Hyperic
- Eucalyptus
- Reductive Lbs Puppet
- OpenQRM
- Appistry

Platform Services

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 Intelligence
- Aster DB
- Quantivo
- Cloud9 Analytics
- Blink Logic
- K2 Analytics
- LogiXML
- Oco
- Panorama
- PivotLink
- Sterna
- ColdLight Neuron
- Infobright
- Vertica

Integration
- Amazon SQS
- MuleSource Mule OnDemand
- Boomi
- SnapLogic
- OpSource Connect
- Cast Iron
- Microsoft BizTalk Services
- gnip
- SnapLogic SaaS Solution Packs
- Appian Anywhere
- HubSpan
- Informatica On-Demand

Development & Testing
- Keynote Systems
- Mercury
- SOASTA
- SkyTap
- Aptana
- LoadStorm
- Collabnet
- Dynamsoft

Database
- Google BigTable
- Amazon SimpleDB
- FathomDB
- Microsoft SDS

Software Services

Billing
- Aria Systems
- eVapt
- OpSource
- Redi2
- Zuora

Financials
- Concur
- Xero
- Workday
- Beam4d

Legal
- DirectLaw
- Advologix
- Fios
- Sertifi

Sales
- Xactly
- LucidEra
- StreetSmarts
- Success Metrics

Desktop Productivity
- Zoho
- IBM Lotus Live
- Google Apps
- Desktoptwo
- Parallels
- ClusterSeven

Human Resources
- Taleo
- Workday
- iCIMS

Content Management
- Clickability
- SpringCM
- CrownPoint

Backup & Recovery
- JungleDisk
- Mozy
- Zmanda Cloud Backup
- OpenRSM
- Syncplicity

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

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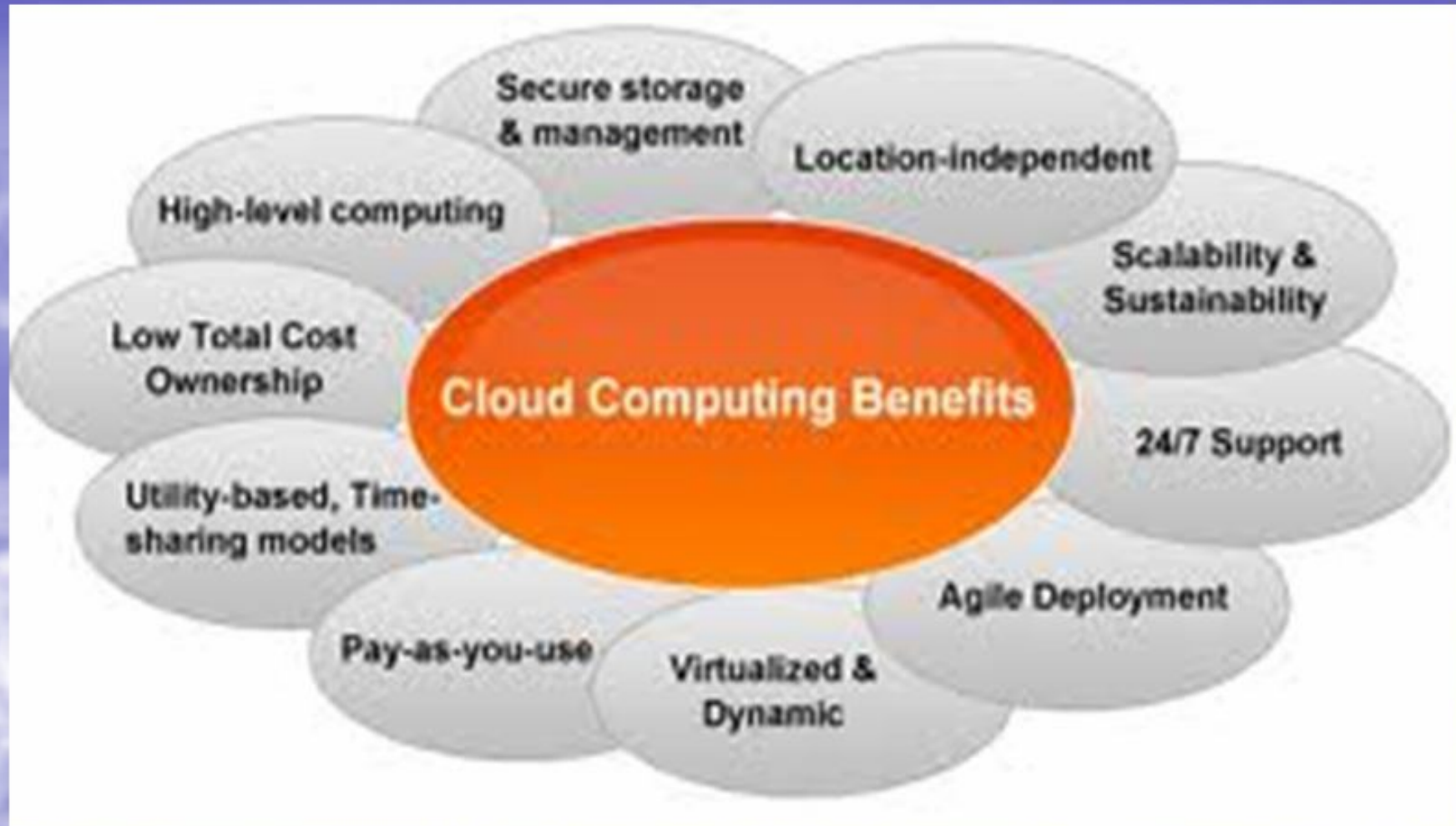- Xythos
- Knowledge TreeLive
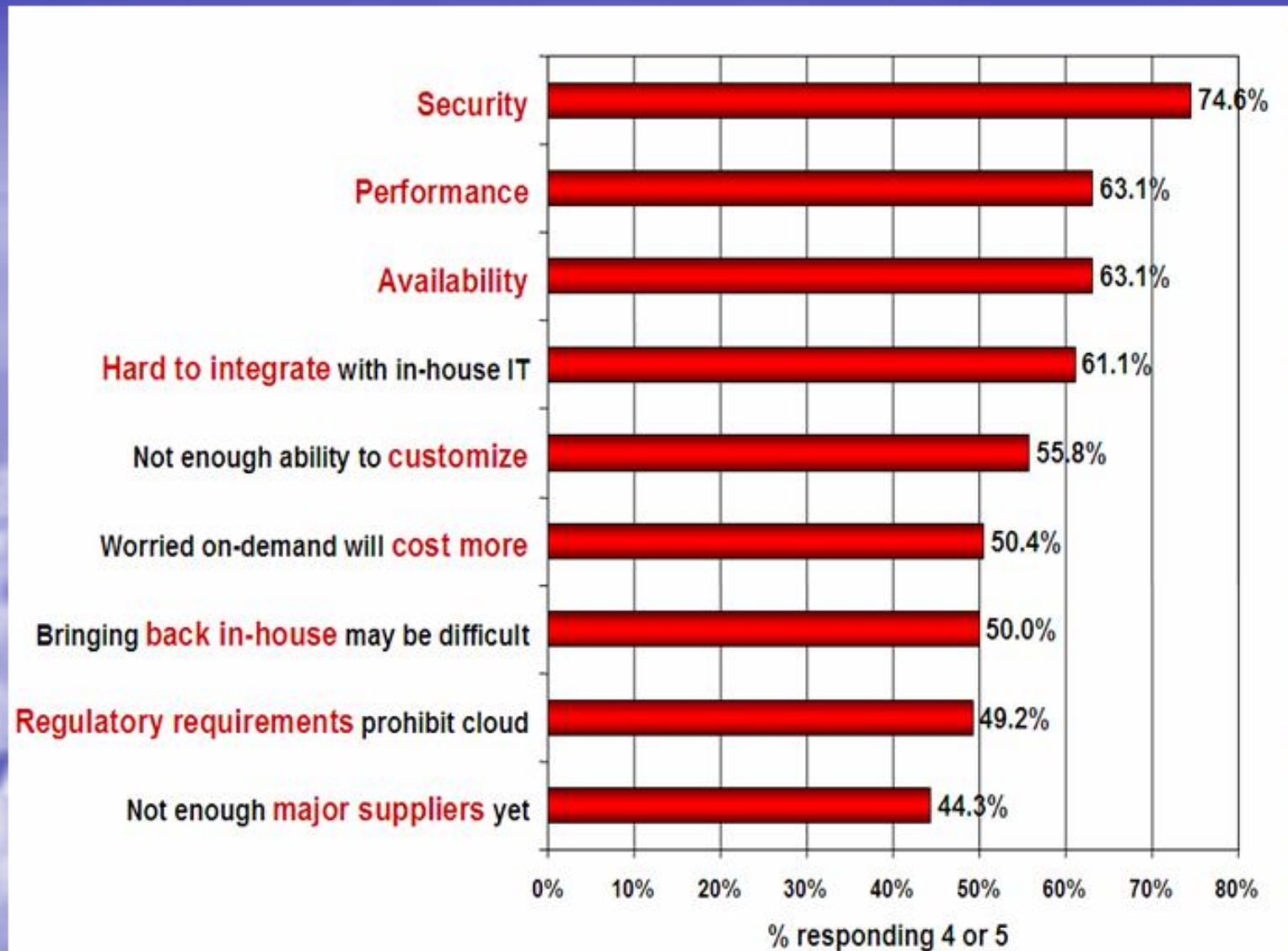- SpringCM

Collaboration
- Box.net
- DropBox

Social Networks
- Ning
- Zembly
- Amitive

OpenCrowd

Updated as of May 4, 2009

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Cloud Computing Benefits

Issues with cloud computing

Chart: % responding 4 or 5

- Security: 74.6%
- Performance: 63.1%
- Availability: 63.1%
- Hard to integrate with in-house IT: 61.1%
- Not enough ability to customize: 55.8%
- Worried on-demand will cost more: 50.4%
- Bringing back in-house may be difficult: 50.0%
- Regulatory requirements prohibit cloud: 49.2%
- Not enough major suppliers yet: 44.3%

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Issues with cloud computing

- Privacy
- Compliance
- Performance
- Legal
- Open Source
- Open Standard
- Security
- Sustainability