Lesson 2
CC Architecture

- Reading list
  - Cloud Computing bible, B.Sosinsky, John Wiley & Sons, 2010
  - Cloud Computing: principles and paradigms, R.Buyya, 2011
  - Cloud Computing, V.K. Pachghare, 2016

Abbreviations

- CSP – Cloud Service Provider
- SOA – Service Oriented Architecture
- SSL – Secure Socket Layers
- SLA – Service Level Agreement
- IoT – Internet of Things
- BDaaS – Big Data as a Service
- DoS – Denial of Service
- CSA – Cloud Security Alliance
- IDS – Intrusion Detection Service (firewall)
- NIST - National Institute for Standard and Technology
- VMMs – Virtual Machine Management
- ROI – Return on Investment
- TCO – Total Cost of Ownership

Cloud Computing Architecture

Broadly classified as follow :

- **Front end**

  The client or <u>user side</u> of the cloud computing model is called front end, which consists of user's computer, application and interfaces needed to access the cloud platform.
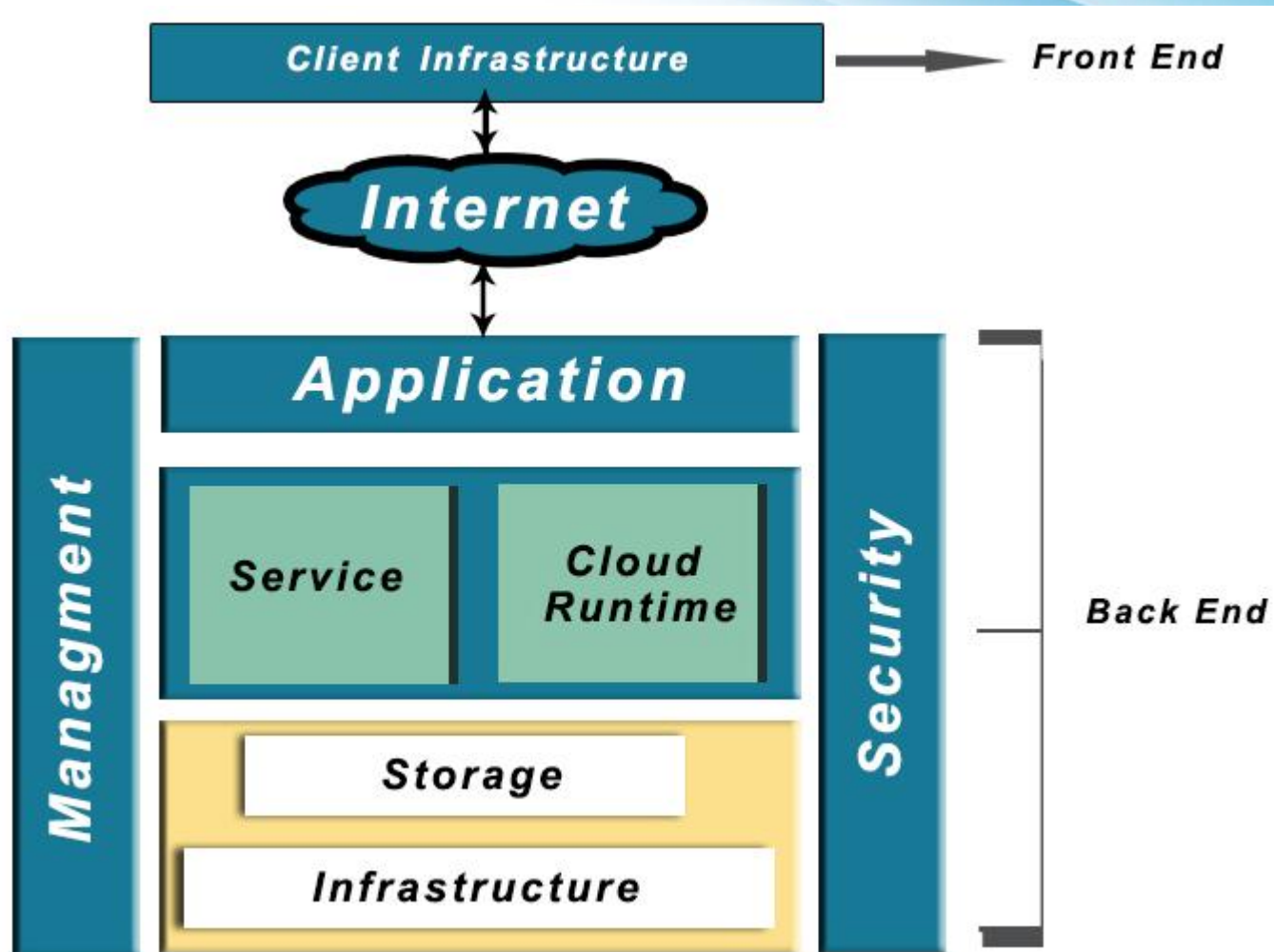
- **Back end**

  The cloud model itself is called back end, which includes all the resources such as

  - Computers
  - Servers
  - Storage devices
  - Deployment models
  - Virtual Machines
  - Services
  - Security mechanisms

  Back end provides traffic control, built-in security and different protocols.
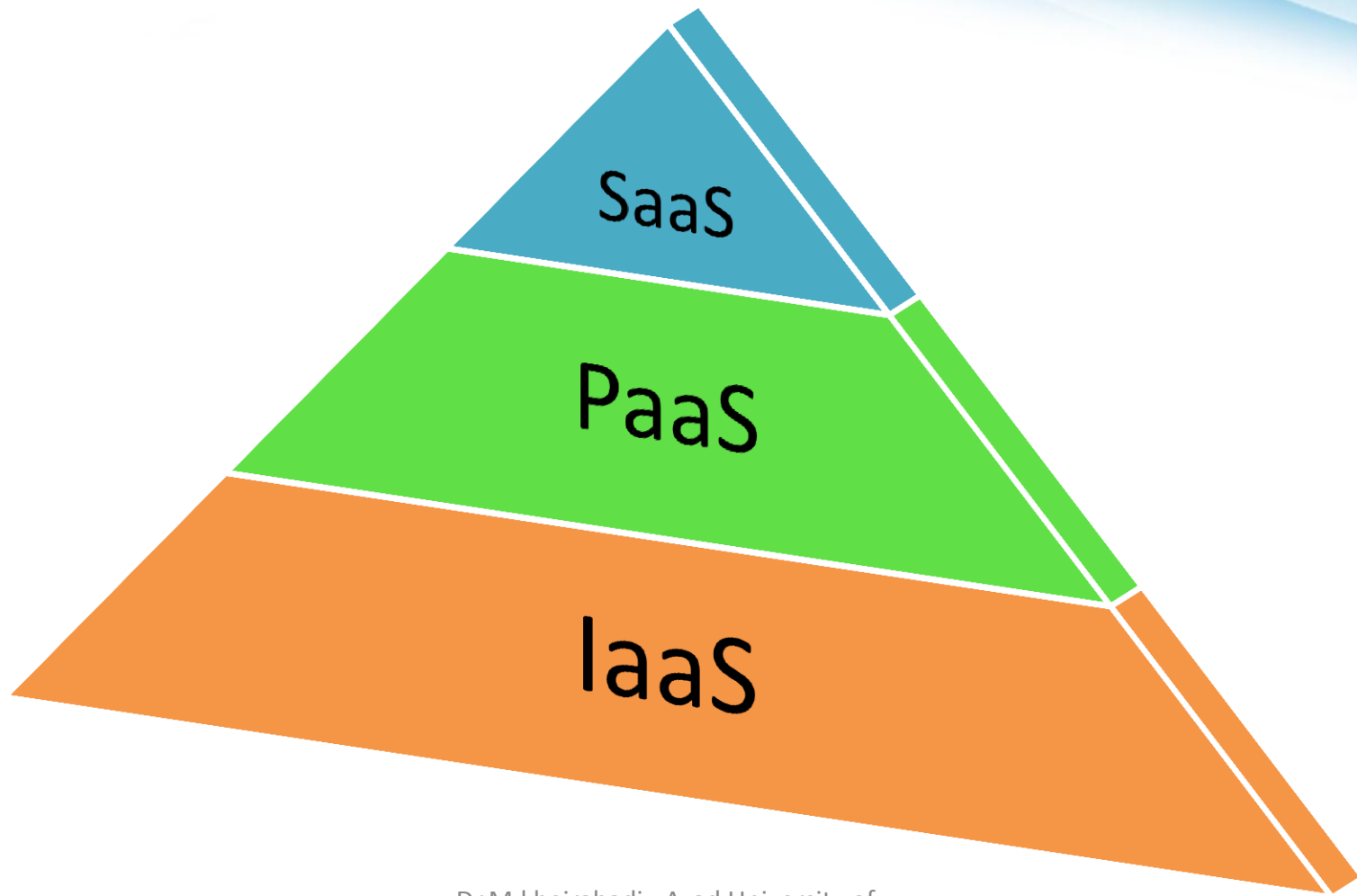
Front end and Back end

Cloud Computing Models

Models are broadly classified by NIST into

- **Serviced Models**
  - Saas, Paas, IaaS

- **Deployment Models**
  - Public, Private, Hybrid, Community

Cloud Service Models

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Cloud Service models - Definitions

Software as a Service (SaaS)
- SaaS is a software delivery methodology that provides licensed multi-tenant access to software and its functions remotely as a Web-based service.

Platform as a Service (PaaS)
- PaaS provides all of the facilities required to support the complete life cycle of building and delivering web applications and services entirely from the Internet.

Infrastructure as a Service (IaaS)
- IaaS is the delivery of technology infrastructure as an on demand scalable service.

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Software as a Service (SaaS)

- Applications are hosted by a CSP
- Access applications, available on the cloud infrastructure over a network via Internet through client interface
- Cloud computing infrastructure shared between multiple users
- The consumer does not manage or control
  - cloud infrastructure
  - network
  - servers operating systems
  - storage
  - individual application capabilities
- It supports SOA and web services
- Pay per use model, benefit use of licensed software without installation, management, upgrade, licensing hassles
- The security of SaaS model is provided by SSL and web service security

Advantages of SaaS

- Reduce time
  - The software and applications are already installed , after the user request, those are ready to use

- Reduce cost
  - Reduce the hardware and software cost, maintenance, upgrade, make it affordable to businesses and individuals

- Scalability and integration
  - Scale up or down easily as demanded, no need to worry about additional infrastructure

- Easy to use
  - User-friendly, run on web browsers

Disadvantages of SaaS

- Robustness
  - May not be strong as traditional software/applications, due to the limitation of the web (intolerance to slow internet connection)
- Privacy
  - Data stored in the cloud! Confidentiality, control, access, authorization
- Security
  - Use internet to transfer data! Attract the attackers (through the loopholes of the applications), IDS firewall are not sufficient to provide security...VMMs have many bugs
- Reliability
  - Normally reliable, but its down time is predictable!

Platform as a Service (PaaS)

- Builds an environment which supports development of applications
- Has variety of applications, uploaded and available on the server by CSP
- Complex applications can be created using PaaS, e.g. Enterprise resource planning system. Based on SOA... helping businesses use any applications without purchasing costly hardware, installation, maintaining Oss, storage, ...
- Responsible for entire application development, deployment, integrity and maintenance
- Provide and manage infrastructure at the lower level
- Can rent hardware, storage, OS and network capacity

Benefits of PaaS

Simple, Developer Friendly Commands & API

- Auto-detect frameworks

- "Push and it works"
  - .WAR
  - Dockerfile
  - .NET

- Simple service binding

- Agile Microservices
  Easy to add and customize

Operational Benefits for Every Application

- Instant dynamic routing

- Log stream aggregation

- Access controls & policies

- Built-in Containerization

- APM & Operational metrics

- 4 Layers of High Availability
  - App-Instance
  - Availability Zone
  - Process
  - Virtual Machine

Built-in and Ecosystem Services

- Applications
  - Rabbit MQ
  - MySQL HA
  - Cassandra
  - Elasticsearch
  - Jenkins (CI)
  - Memcached
  - MongoDB
  - Neo4j
  - Redis
  - Riak CS

- Data/Analytics
  - Elastic Hadoop
  - HAWQ
  - GemFire XD

- Mobile
  - Push Notification
  - Data Synch
  - API Gateway

Easy to add and customize

Issues in Pass

- Customer captivity
  - Stuck with a provider*
  - Agreement Issues **
  - Changes in the policies of the provider ***
- Data Security
- Limited flexibility , compared with IaaS
- Problem of integration
  - Combination of services may cause difficulty for the users

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Important factors to select type of PaaS

- Size of the organization

- Resources required for the maintenance of the services or processes

- Resources required for the maintenance of the infrastructure

- Flexibility

- Requirement about security and compliance

Type of PaaS

- ***Based of deployment method***
  - **Public PaaS** → limited to certain framework, languages, database and etc. suitable for small businesses
  - **Private PaaS** → customize unique requirements, controlled by the business, more privacy, storage location can be controlled
  - **Hybrid PaaS** → using benefits of privacy of private cloud, and development benefits of public cloud
- ***Based on functions performed***
  - **Standalone development environments** → specific function, does not consist any applications
  - **Application delivery-only environments** → on demand scaling
  - **Open platform as a service** → support open source software
  - **Add-on development facilities** → can be customized using add-on

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PaaS Solutions

- Social application development platforms
  - Developing applications that can be used in different platforms, such as social websites

- Web-based application add-on platforms
  - Allows customized SaaS and add components/features

- Standalone business application platforms
  - Offer generalized development environment

- Open computing platforms
  - Support application development, can use any server, language, OS, Database virtually

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Infrastructure as a Service (IaaS)

- Responsible to provide the hardware
- Offers basic services into one platform
  - Virtual servers
  - Data storage
  - Database
  - Users can use the above to deploy and run applications
  - Users can develop VMs, VS and Virtual infrastructure using this hardware

IaaS (Continued)

- Infrastructure are managed and maintained by the service provider
- Provides foundations for PaaS and SaaS
- Provides standard, flexible virtual environment
- Clients/users are responsible all other aspects of deployment , e.g.
  - OS
  - Applications
  - User interactions
- you control the virtual machines and the services running on the VMs you create

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Key concepts of IaaS

- Cloud bursting
  - When the demand for Computing capacity spikes (increase sharply) an application runs in a private cloud or data center and bursts into a public cloud.
  - The advantage : only pays for extra compute resources when they are needed.
  - The Issue: potential for incompatibility between the different environments and the limited availability of management tools
  - recommended for high performance, non-critical applications that handle non-sensitive information.

Key concepts of IaaS (Continued)

- Multi-tenant Computing
  - an architecture in which a single instance of a software application serves multiple customers.
  - Tenants may be given the ability to customize some parts of the application, such as color of the user interface (UI) or business rules, but they cannot customize the application's code.

Benefits of IaaS

- Allows IT to shift focus
  - Have time for innovations and provide solutions
- Flexible and efficient service
  - Different users have different requirements
- Utility Service
  - Pay per use, as long as needed
- Dynamic Scaling
  - If demands increase/ decrease scale accordingly
- Portability
  - Using VMs allows user to use different platforms

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Issues of IaaS

- VMs collapse
- You do not control the underlying compute, network and storage infrastructure
- Data leakage protection and usage monitoring
- Authentication and authorization
- Incident response and forensics capabilities

Identity as a service(IDaaS)

- Information related with a digital media stores
- Used in electronic communications
- Storage of data, query and policy engine – maintain integrity of data
- Identity is the important component for better trust
- Important component of inter-networked systems

What is an identity?

- Who you are
  - Age , gender , id number, finger print, appearance,
  - Biometric information
- What you have
  - Bank accounts, properties, …
- What are you related to
  - Family, friends, activities, habits, …

How IDaaS is used?

- Government
- Authentication services
- Risk and event monitoring
- Identity and profile management
- Single sign-on services (SSO)
  - Lightweight Directory Access Protocol (LDAP) and stored LDAP databases on (directory) servers
- Directory Services
- Registration

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Cloud Service models - Comparison

Source: Microsoft.
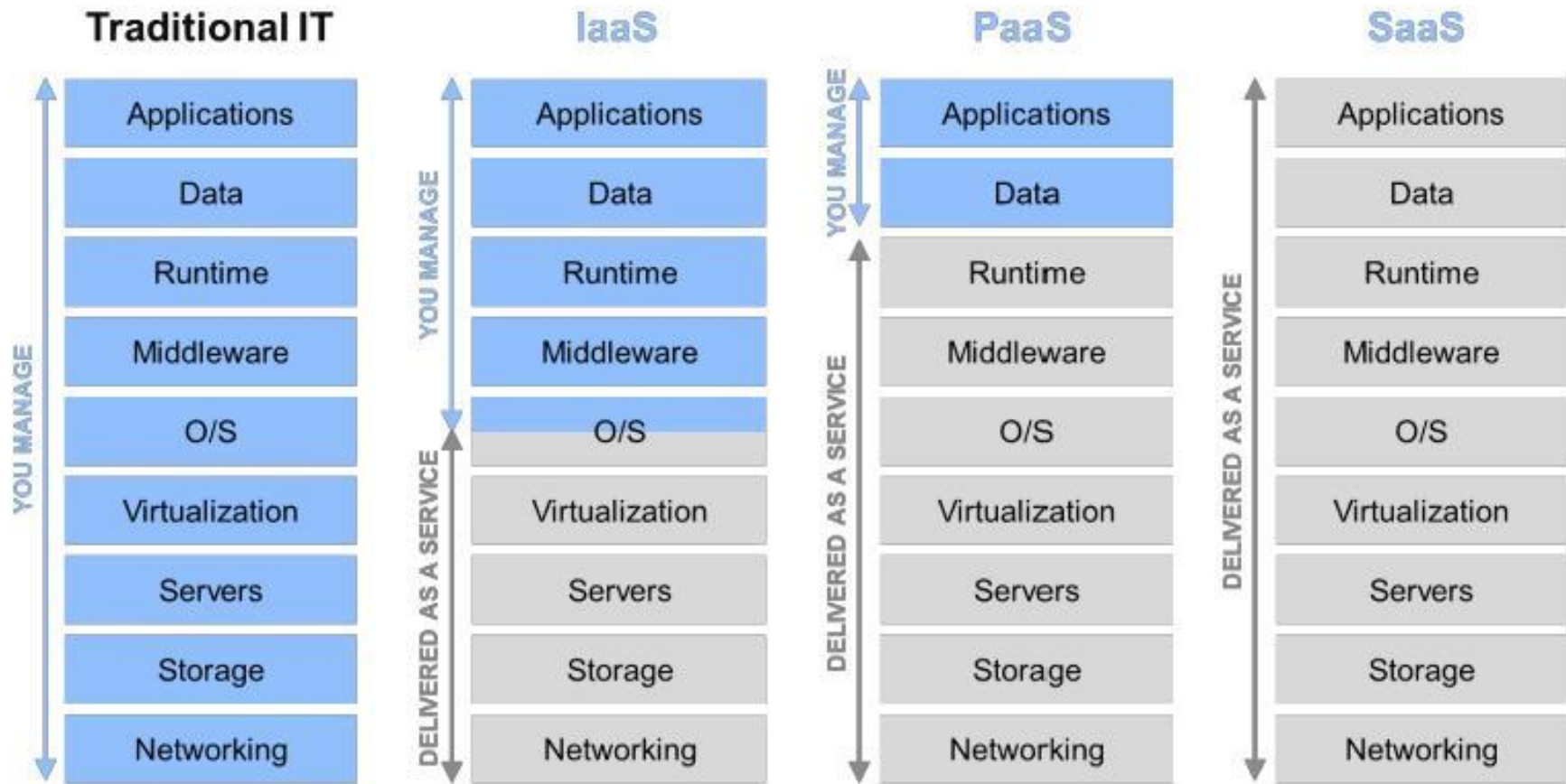
Conclusion

- Cloud architecture broadly classified as front-end and back-end architecture

- Service models are responsible for the performance and availability of the virtual infrastructure

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References

- Cloud Computing, V.K. Pachghara, 2016, PHI Learning Private Limited
- http://searchcloudcomputing.techtarget.com, M. Rouse, accessed on 19 Oct 2016
- http://whatis.techtarget.com/definition/multi-tenancy, M. Rouse, accessed on 19 Oct 2016