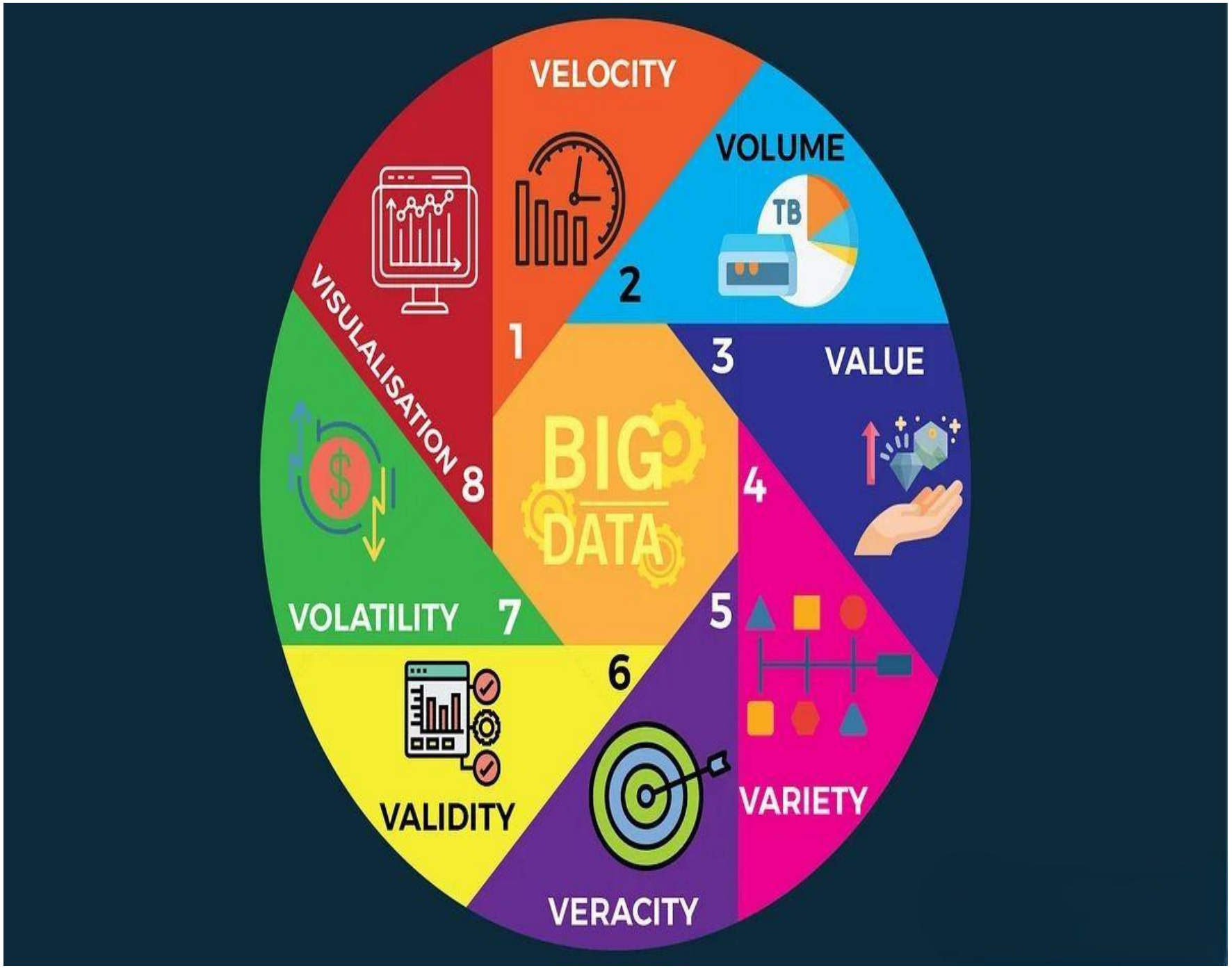

CS 3032: Big Data

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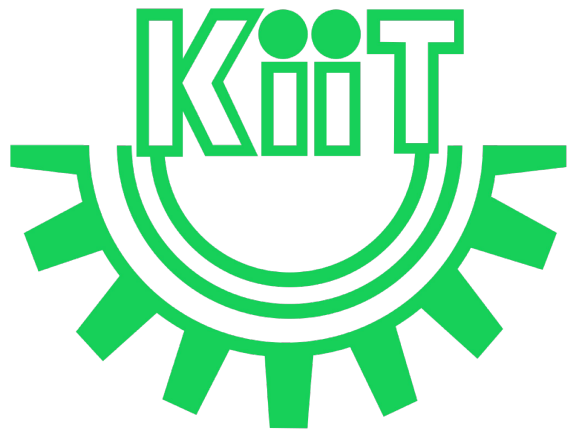
In this Discussion . . .

- Cloud Computing and Big Data



Cloud Computing

- Cloud computing is the use of computing resources (hardware and software) that are delivered as a service over a network (typically the Internet). It’s a virtualization framework.
- It is like a resource on demand whether it be storage, computing etc. Cloud follows pay per usage model and one need to pay the amount of resource usage.

Cloud Computing

- This computing service by cloud charges users based only on the amount of computing resources we use.
  - So for example, if you want to give demo to a client on a cluster of more than 100 machines and you do not have so many machines currently available with you, then in such case cloud computing plays a very important role.

Cloud Computing

Cloud plays an important role within the Big Data world, by providing horizontally expandable and optimized infrastructure that supports practical implementation of Big Data.

- In cloud computing, all variety/volume of data is gathered in data centers and then distributed to the end-users.
- Further, automatic backups and recovery of data is also ensured for business continuity, all such resources are available in the cloud.

Cloud Computing Features

- **Scalability:** Scalability is provided by using distributed computing.
- **Elasticity:**
  - Customers are allowed to use and pay for only that much resource which they are using.
  - In cloud computing, *elasticity* is defined as the degree to which a system is able to adapt to workload changes in an autonomic manner, so that at any time the available resources match the current demand as closely as possible.

Cloud Computing Features (Contd.)

- **Fault Tolerance:**
  - Allows recovery in case of a part in cloud system fails to respond.
- **Resource Pooling:**
  - Same resources are allowed to be used by multiple organizations.
  - The computing resources are pooled for serving various consumers via multi-tenant model (Multi-tenancy is an architecture in which a single instance of a software application serves multiple customers. Each customer is called a tenant), with different resources dynamically assigned and re-assigned according to consumer demand.

Cloud Computing Features (Contd.)

- **Self Service:**
  - Customers are provided easy to use interface through which they can choose services they want.
  - A consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed without requiring human interaction.
- **Low cost:**
  - It charges you based only on the amount of computing resources we use and you need not buy expensive infrastructure.
  - Pricing on a utility computing basis is usage-based and fewer IT skills are required for implementation.

Cloud Computing & Big Data

- In cloud computing, all data is gathered in data centers and then distributed to the end-users.
- Further, automatic backups and recovery of data is also ensured for business continuity, all such resources are available in the cloud.
- There are multiple ways to access the cloud, i.e., Cloud services are categorized as below:
  - **Infrastructure-as-a-Service** (**IaaS**)
  - **Platform-as-a-Service** (**PaaS**)
  - **Software-as-a-Service** (**SaaS**)

Cloud Computing & Big Data (as-a-Service)

- IaaS, PaaS and SaaS are not mutually exclusive. Many mid-sized businesses use more than one, and most large enterprises use all three.
- '**as-a-service**' refers to the way IT assets are consumed in these offerings - and to the essential difference between cloud computing and traditional IT.
- In traditional IT, an organization consumes IT assets - hardware, system software, development tools, applications - by purchasing them, installing them, managing them and maintaining them in its own on-premises data center.

Cloud Computing & Big Data (as-a-Service)

- In cloud computing, the cloud service provider owns, manages and maintains the assets; the customer consumes them via an Internet connection, and pays for them on a subscription or pay-as-you-go basis.

So the chief **advantage of IaaS, PaaS, SaaS or any 'as a service' solution** is **economic**: A customer can access and scale the IT capabilities it needs for a predictable cost, without the expense and overhead of purchasing and maintaining everything in its own data center. But there are additional advantages specific to each of these solutions.

Cloud Services: Infrastructure-as-a-Service (IaaS)

- Infrastructure as a service (IaaS) is an on-demand access to cloud-hosted physical and virtual servers, storage and networking, i.e., the backend IT infrastructure for running applications and workloads in the cloud.

Cloud Services: Infrastructure-as-a-Service (IaaS)

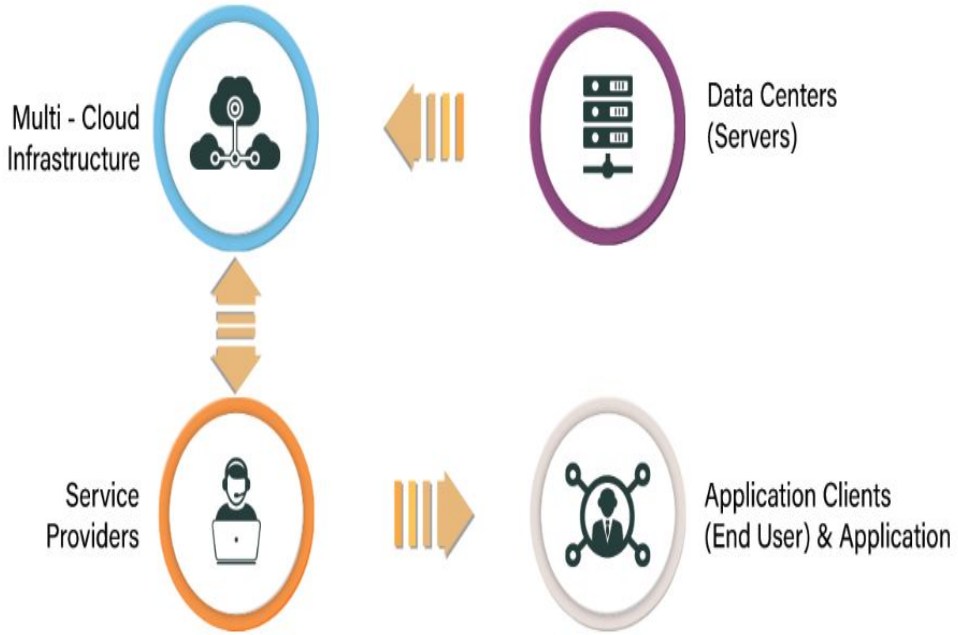
- IaaS is on-demand access to cloud-hosted computing infrastructure - servers, storage capacity and networking resources - that customers can provision, configure and use in much the same way as they use on-premises hardware.
- The difference is that the cloud service provider hosts, manages and maintains the hardware and computing resources in its own data centers.
- IaaS customers use the hardware via an internet connection, and pay for that use on a subscription or pay-as-you-go basis.

Cloud Services: Infrastructure-as-a-Service (IaaS)

- Infrastructure as a service (IaaS) is a cloud-based computing service that provides leased servers to enterprises for remote computing and storage applications.
- Users leverage IaaS to run software or store data on remote infrastructure without having to directly pay for the operating and maintenance costs of the said infrastructure.
- Instead, **clients need to pay a recurring subscription fee usually based on the number of server resources used.**

Cloud Services: Infrastructure-as-a-Service (IaaS) (Contd.)

- With IaaS, organizations no longer need to procure, set up, operate, and manage their own data centers.
- Also, as with other ‘as a service’ solutions, infrastructure as a service can be scaled up (or down) automatically, depending on client requirements.
- Additionally, most leading IaaS vendors provide a robust service level agreement (SLA) for uptime and performance.
- Further, IaaS gives client companies access to servers closer to their end customers, thus addressing both technical and regulatory requirements with ease.



How IaaS Works

Cloud Services: Infrastructure-as-a-Service (IaaS) Examples

- **Production IaaS:** Production IaaS environments are designed to provide enterprises with the capability of running live systems and applications from the cloud. This type of IaaS can enhance the performance of operating systems, application servers, and databases.

Cloud Services: Infrastructure-as-a-Service (IaaS)

- IaaS can be thought of as the original 'as a service' offering: Every major cloud service provider - Amazon Web Services, Google Cloud, IBM Cloud, Microsoft Azure - began by offering some form of IaaS.

Benefits	Use cases
Higher availability	Disaster recovery
Lower latency, improved performance	Ecommerce
Improved responsiveness	Internet of Things (IoT), event processing, artificial intelligence (AI)
Comprehensive security	Startups
Faster access to best-of-breed technology	Software development

Cloud Services: Infrastructure-as-a-Service (IaaS) Examples

- **Test and development IaaS:** Another major type of infrastructure as a service is the test and development IaaS environment.
  - Often, developers require a specific technical infrastructure only for a short period to test the live viability of their workloads.
  - The attractive pay-as-you-go subscription models offered by IaaS vendors mean that this type of IaaS is an economical solution for application development and testing.
  - Test and development type IaaS allows for testing at any scale as and when required, without significant investments.

Cloud Services: Infrastructure-as-a-Service (IaaS) Examples

- **Replication IaaS:** A replication type IaaS environment is designed to efficiently process the workloads required for business continuity, high availability replication, and disaster recovery.
  - Most IaaS providers feature replication environments that support all major operating systems, including Windows, Linux, and IBM.

Cloud Services: Software-as-a-Service (SaaS)

- Software-as-a-Service, is on-demand access to ready-to-use, cloud-hosted application software.

Cloud Services: Software-as-a-Service (SaaS)

- SaaS (sometimes called cloud application services) is cloud-hosted, ready-to-use application software.
- Users pay a monthly or annual fee to use a complete application from within a web browser, desktop client or mobile app.
- The application and all of the infrastructure required to deliver it - servers, storage, networking, middleware, application software, data storage - are hosted and managed by the SaaS vendor.

Cloud Services: Software-as-a-Service (SaaS)

- Software-as-a-Service, widely known as SaaS, is a method of delivering applications over the internet.
- The ‘as a service’ aspect of SaaS means that companies do not have to worry about installing, renewing, or maintaining software on-premises.
- Instead, they can simply access whatever service they need and pay for only what they use.

Cloud Services: Software-as-a-Service (SaaS)

- Software-as-a-Service applications are disseminated over the internet, freeing client companies from the need for complicated and often expensive hardware and software management.
- Other terms for SaaS include on-demand software, web-based software, and hosted software. SaaS applications operate from the servers of a remote vendor.
- This vendor manages most aspects of the application, including access, availability, security, and performance. Clients can usually access the service that they have subscribed to through a web browser.

Cloud Services: Software-as-a-Service (SaaS)

- Today, anyone who uses a or mobile phone almost certainly uses some form of SaaS.
  - Email, social media, and cloud file storage solutions (such as Dropbox or Box) are examples of SaaS applications people use every day in their personal lives.
  - Popular business or enterprise SaaS solutions include Salesforce (customer relationship management software), HubSpot (marketing software), Trello (workflow management), Slack (collaboration and messaging), and Canva (graphics).
  - Many applications designed originally for the desktop (e.g., Adobe Creative Suite) are now available as SaaS (e.g., Adobe Creative Cloud).

Cloud Services: Software-as-a-Service (SaaS)

Benefits
Minimal risk
Anytime/anywhere productivity
Easy scalability

Cloud Services: Software-as-a-Service (SaaS)

Cloud Services: Platform-as-a-Service (PaaS)

- Platform-as-a-Service (PaaS): PaaS provides a cloud-based platform for **developing, running, managing applications**.
- The cloud services provider:
  - hosts, manages and maintains all the hardware and software included in the platform -
    - servers (for development, testing and deployment),
    - operating system (OS) software,
    - storage, networking, databases, middleware, runtimes, frameworks, development tools - as well as related services for security, operating system and software upgrades, backups and more.

Cloud Services: Platform-as-a-Service (PaaS)

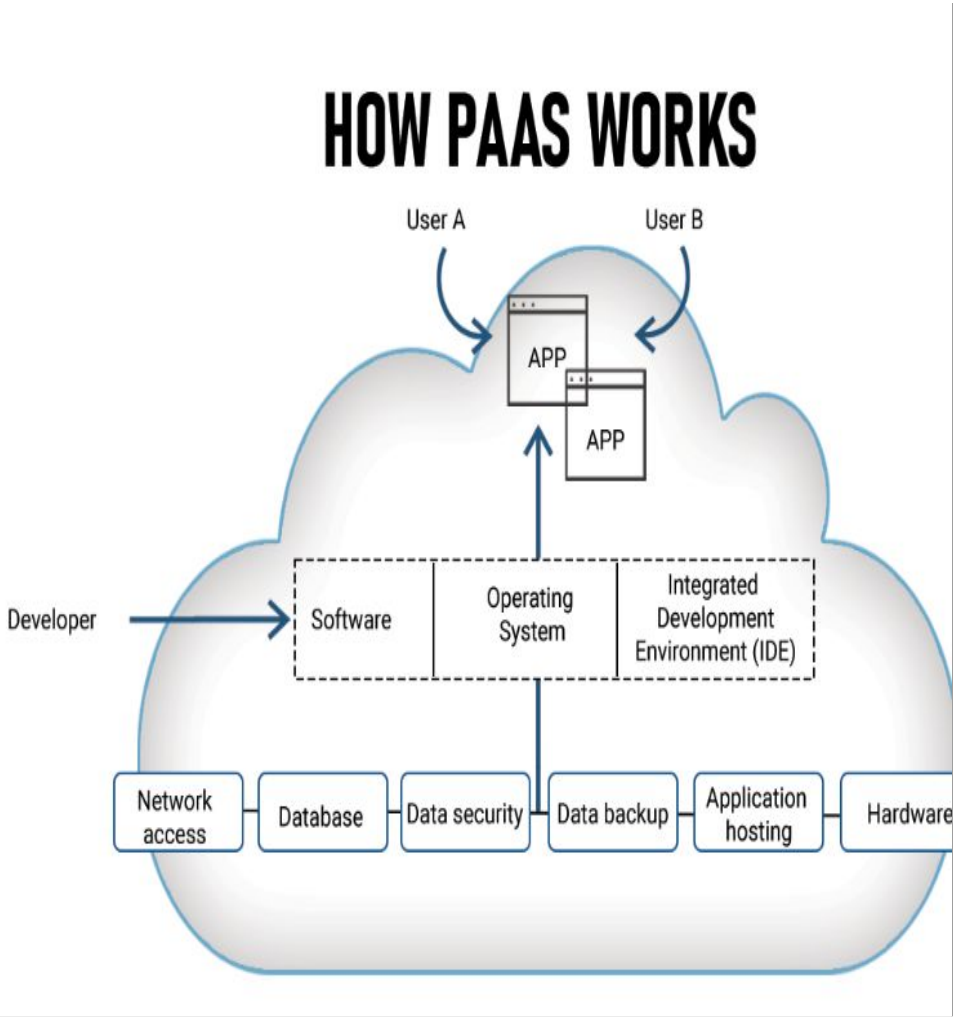
- Users access the PaaS through a graphical user interface (GUI), where development or DevOps teams can collaborate on all their work across the entire application lifecycle including coding, integration, testing, delivery, deployment, and feedback.
- Platform-as-a-Service (PaaS) is a cloud computing platform where a third party offers the necessary software and hardware resources.
- These offerings enable clients to develop, run, and manage business applications without maintaining the infrastructure required for such software development processes.

Cloud Services: Platform-as-a-Service (PaaS)

- Thus, Platform-as-a-Service (PaaS) is on-demand access to a complete, ready-to-use, cloud-hosted platform for developing, running, maintaining and managing applications.

Cloud Services: Platform-as-a-Service (PaaS)

- A typical PaaS model encompasses the physical infrastructure, cloud applications, and a graphic user interface (GUI).
- PaaS architectures are similar to serverless computing or function-as-a-service (FaaS) models.
- In such models, the operating infrastructure is not in sight of the developers and users.
- This compels the cloud service provider to control the operations of underlying servers and resources.
- The PaaS framework uses a dynamic financial model. The computing services are priced based on computations, storage space, and network resources.



Cloud Services: Platform-as-a-Service (PaaS) Examples

Benefits	Use cases
Faster time to market	API development and management
Low- to no-risk testing and adoption of new technologies	Internet of Things (IoT)
Simplified collaboration	Agile development and DevOps
A more scalable approach	Cloud-native development and hybrid cloud strategy
Less to manage	

Examples of PaaS solutions include AWS Elastic Beanstalk, Google App Engine, Microsoft Windows Azure, and Red Hat OpenShift on IBM Cloud.

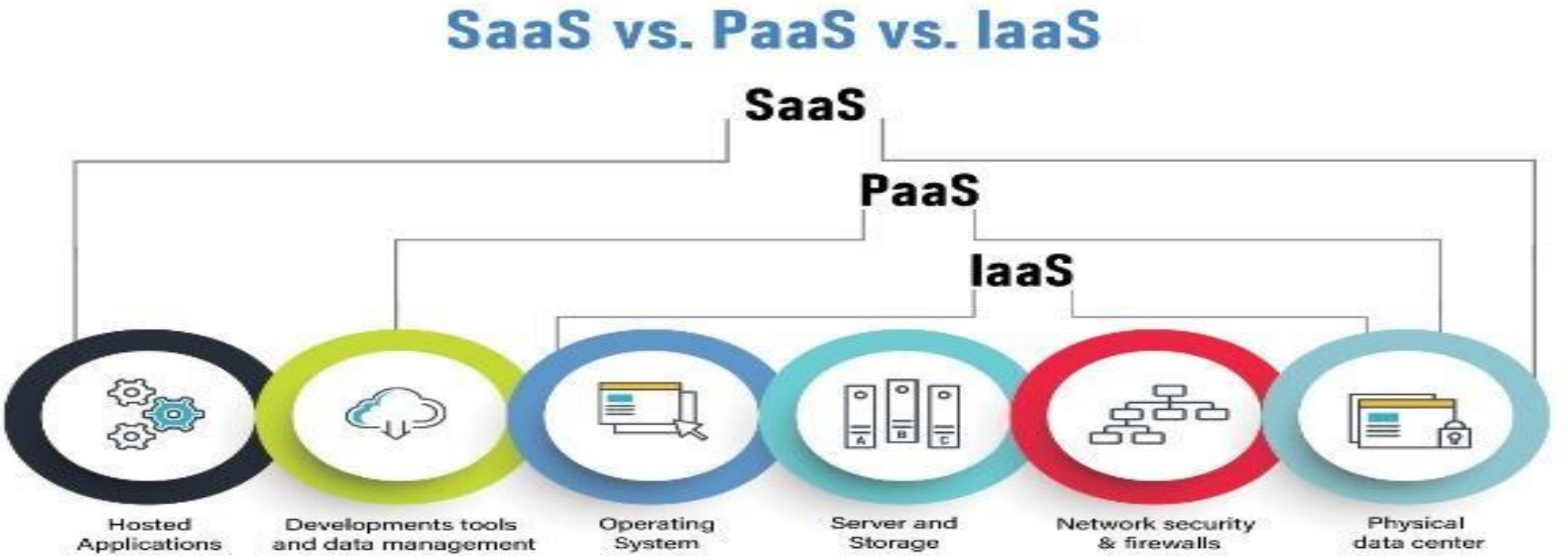
Cloud Services: Platform-as-a-Service (PaaS) Examples

- The cloud services offered by today's leading PaaS providers are equipped to operate across languages, libraries, containers, and equivalent tools. These include computing, storage, databases, developer & management tools, and security.

Cloud Services: Leading Platform-as-a-Service Providers

- The SAP Cloud
- Microsoft Azure
- Salesforce Lightning
- AWS Lambda
- Google App Engine
- Pivotal Cloud Foundry
- AWS Elastic Beanstalk
- IBM Cloud Foundry
- Red Hat OpenShift
- Oracle Cloud Platform

SaaS Vs. PaaS Vs. IaaS



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