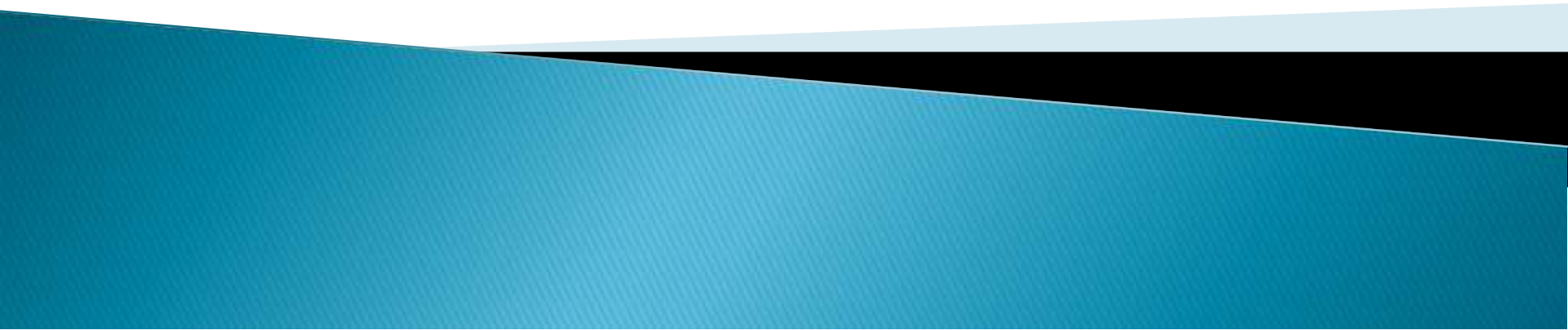


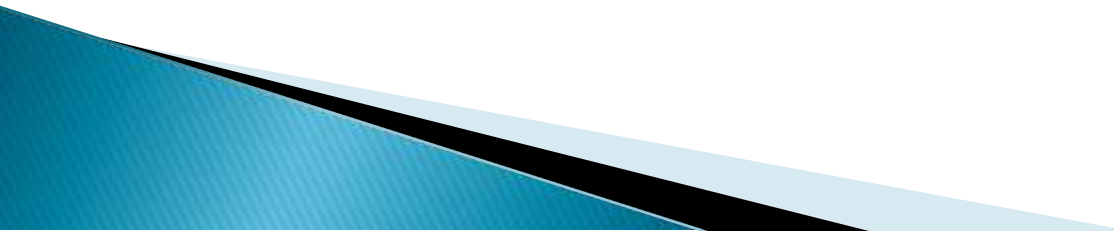
Unit-4

Cloud Computing Technologies and
Applications



Cloud Content Delivery Network (CDN) Services

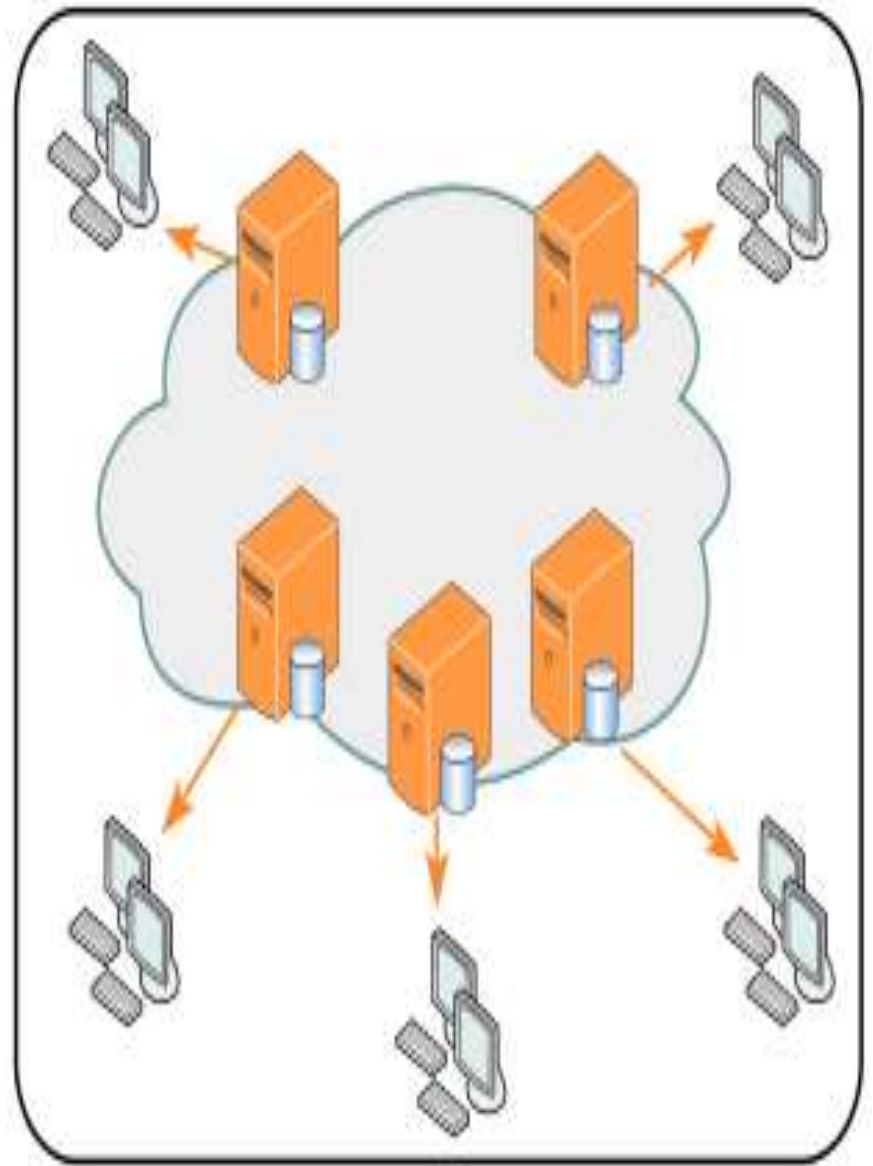
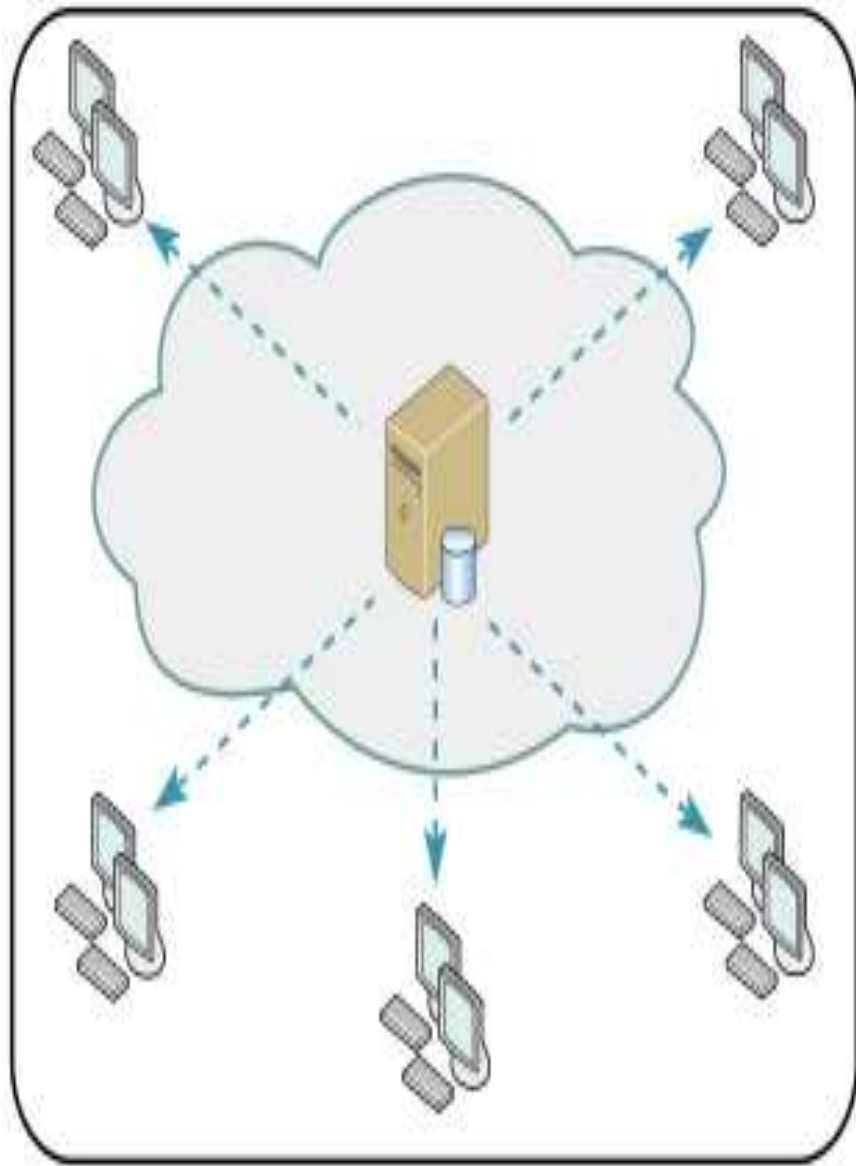
Traditionally, content of the websites is served from one main server or central server which is responsible for serving user requests all the time. If target users of any website are restricted to certain geographical regions, then traditional method works well. However, if target users are distributed across different geographical regions, then this method is not relevant.



Cloud Content Delivery Network (CDN) Services

Content delivery network is a software which solves distributed content delivery problems across all geographical regions; for example, AWS CloudFront is one of the popular content delivery service used by AWS business application users.

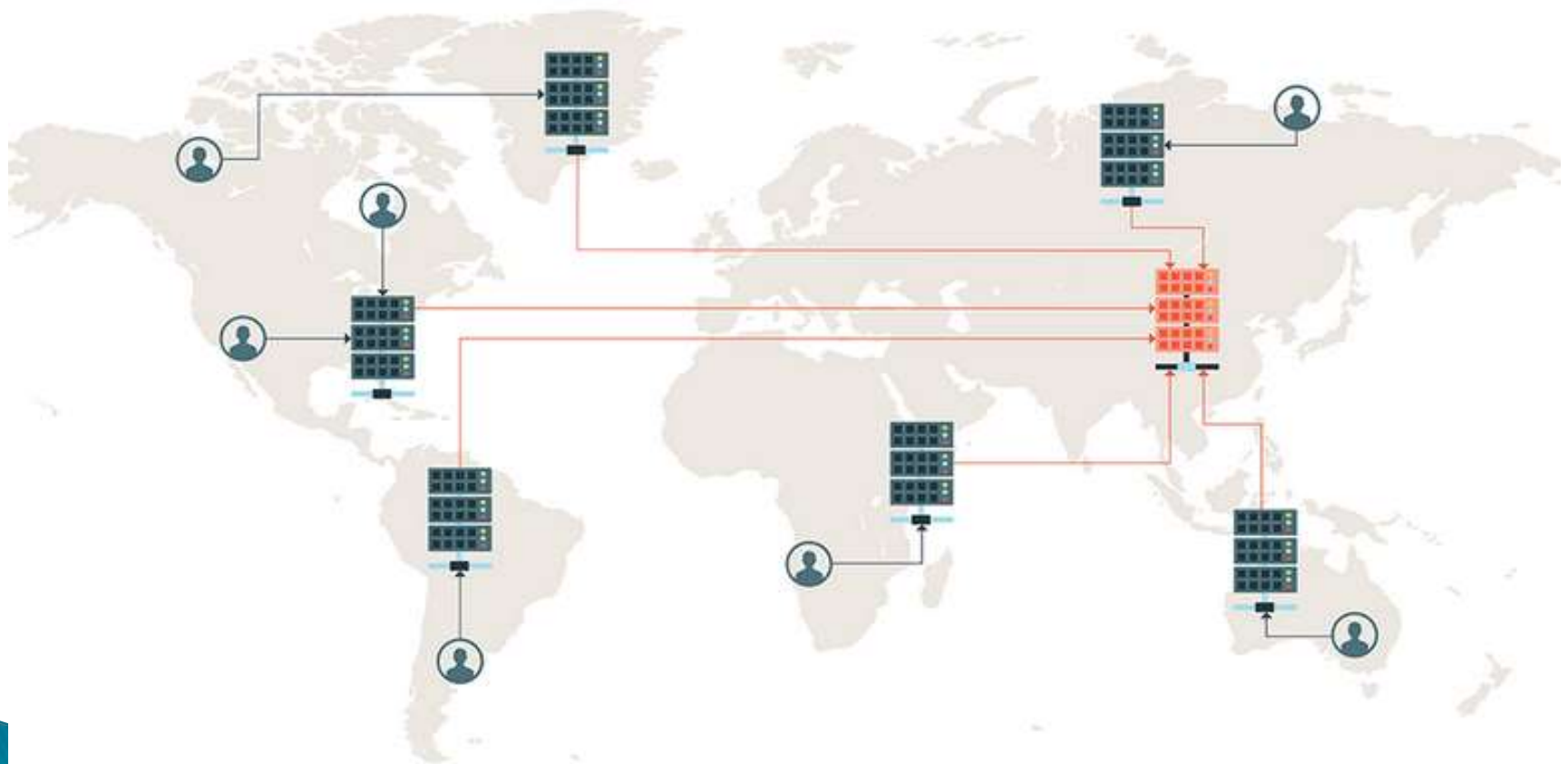




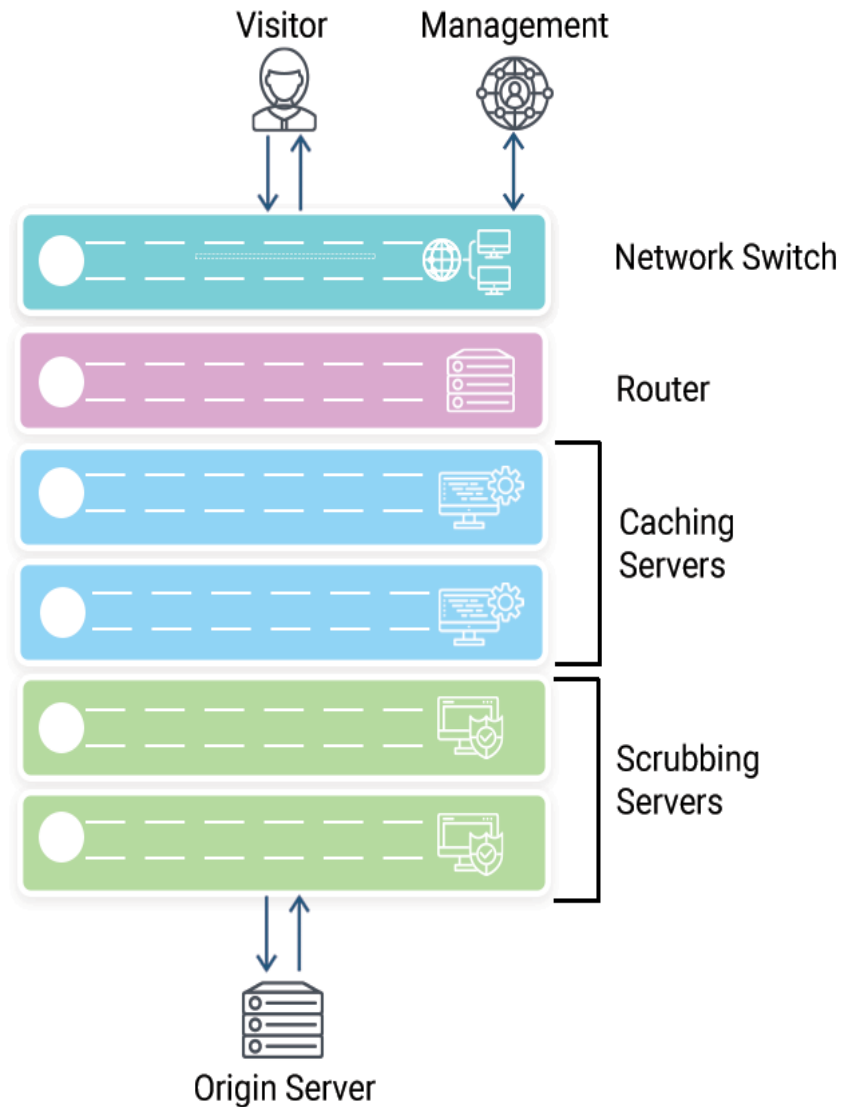
Content delivery network

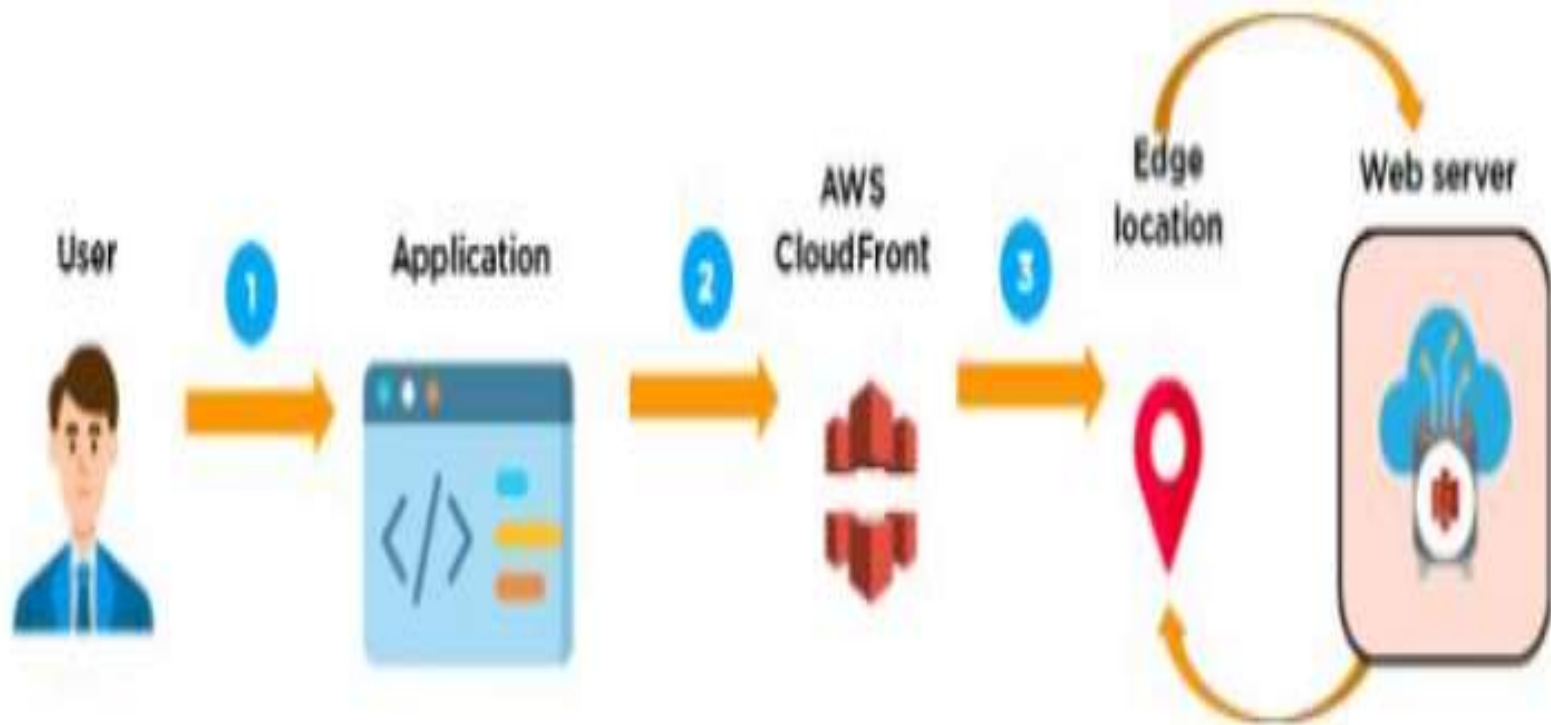
CDNs cache content from the origin server on geographically distributed CDN cache servers to reach users faster.

👤 USER 🖥️ CDN SERVER 🏠 ORIGIN SERVER

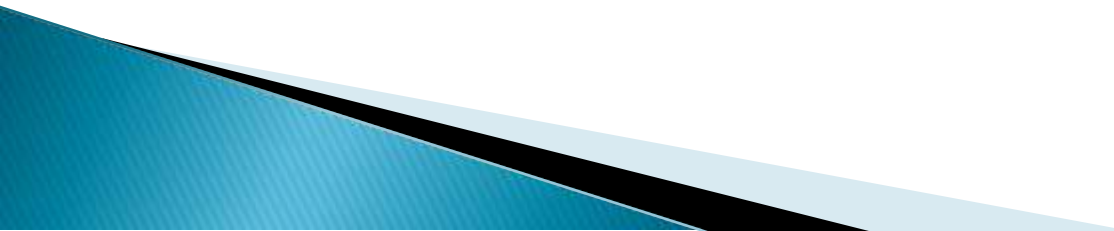


HOW CONTENT DELIVERY NETWORK FUNCTIONS




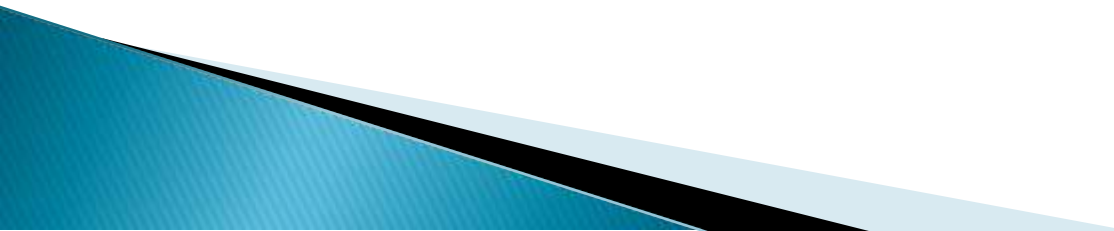


Some other popular CDN services:

- ▶ Akamai
 - ▶ EdgeCast
 - ▶ Level 3
 - ▶ Incapsula
 - ▶ Instart Logic
 - ▶ Aryaka Network
- 

Multi-CDN

- ▶ If your business application needs are purely global and require multiple servers across the globe to give each user a faster website loading experience irrespective of their locations, then the concept of multi-CDN comes into picture.
 - ▶ There is a company, named MetaCDN (<http://www.metacdn.com/>), which provides multi-CDN service. It combines existing CDN providers into one huge global network. It dynamically combines and optimizes all major cloud service providers and infrastructure providers to quickly and securely speed up the Web content to users irrespective of their physical location.
- 

- The need for a multi-CDN strategy arises when an organization's traffic load increases beyond their current capacity limitations on one CDN provider or if they are looking to distribute their content geographically across providers strategically.
 - This is because of the many advantages to hosting content from different CDN providers – geographical redundancy, security, increased performance, and cost savings (multi-CDN can help reduce bandwidth costs by balancing out loads) and taking advantage of the pricing differences between different CDN vendors for different situations, time-slots, etc.
- 

Benefits of Cloud Content Delivery Networks

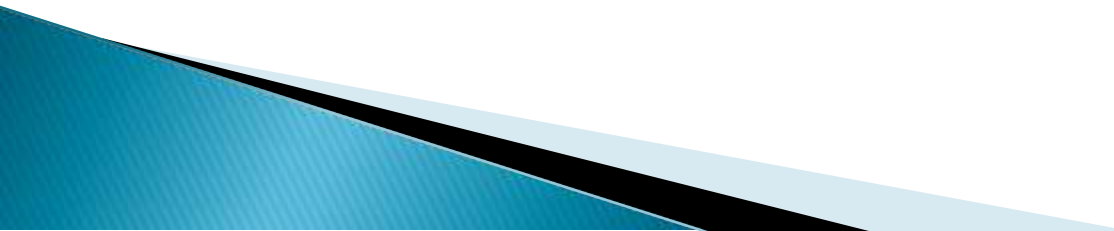
- ▶ CDNs can provide a number of benefits to web applications and websites, such as **improved performance, increased reliability, and reduced bandwidth costs**. CDNs also help to improve website security by providing an extra layer of defense against malicious attacks.

Benefits of Cloud Content Delivery Networks

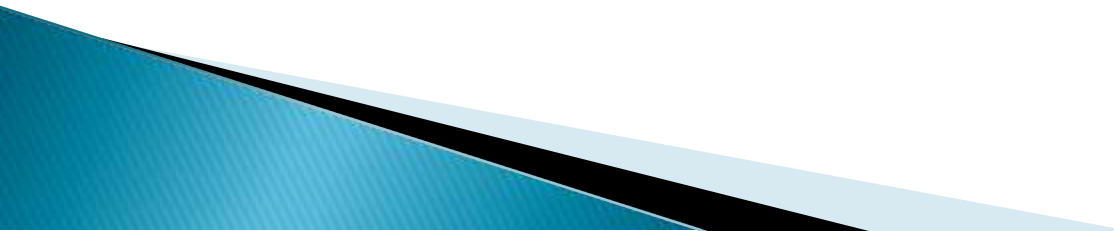
- ▶ CDNs can also help to improve user experience by providing fast, reliable content delivery to users regardless of their location. This can help to reduce latency and improve the overall user experience.



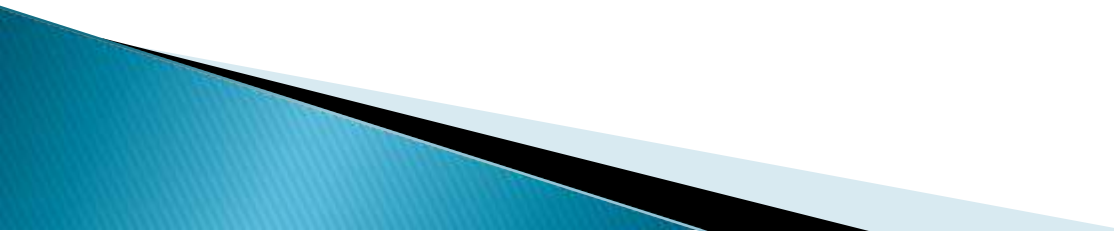
Benefits of Multi CDN

- ▶ One of the main benefits of using a multi-CDN approach is improved website performance. By delivering content from the closest server, it reduces latency and improves page load times. This, in turn, leads to better user engagement and higher conversion rates.
 - ▶ Another benefit is increased reliability. If one CDN fails or experiences downtime, the traffic can be automatically redirected to another CDN, ensuring that the content remains available to users. Multi-CDN also provides better scalability, allowing websites to handle sudden spikes in traffic without affecting performance.
- 

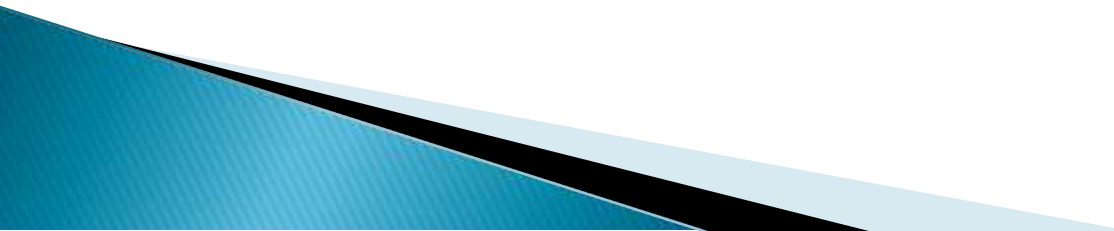
Challenges of Multi CDN

- ▶ While multi-CDN offers many benefits, there are also some challenges that need to be addressed. One of the biggest challenges is managing multiple CDNs. This requires a lot of technical expertise and resources, which can be a challenge for small businesses.
 - ▶ Another challenge is ensuring consistent content delivery across different CDNs. This requires careful configuration and monitoring to ensure that the content is delivered consistently and without any errors.
- 

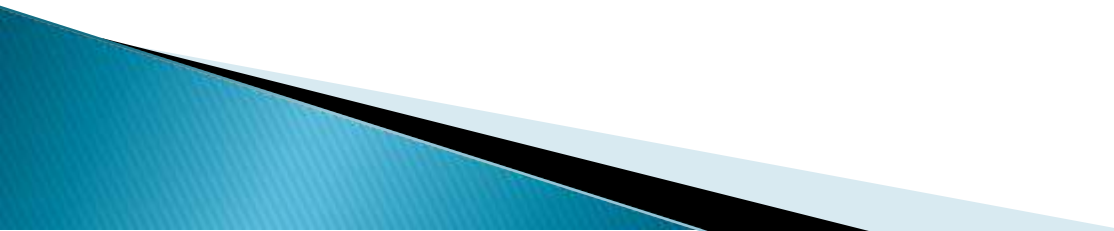
Choosing the Right Multi CDN Approach

- ▶ There are different approaches to implementing multi-CDN, and choosing the right one depends on various factors such as budget, technical expertise, and business needs. One approach is to use a managed multi-CDN service, which provides a **single point** of contact for all CDNs and takes care of the technical details.
 - ▶ Another approach is to build a **custom multi-CDN** solution, which provides more flexibility and control but requires more technical expertise and resources. Ultimately, the choice depends on the specific needs and goals of the business.
- 

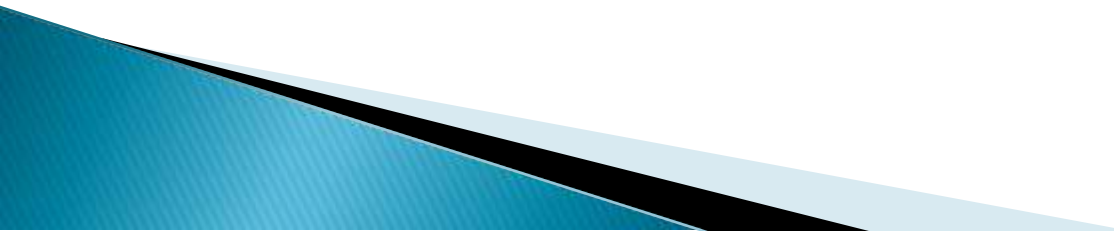
Conclusion

- ▶ Cloud Content Delivery Networks can provide a number of benefits to web applications and websites, such as improved performance, increased reliability, and reduced bandwidth costs. It is important to choose a CDN service that is reliable, secure, and scalable.
 - ▶ CDNs can also help to improve website security and user experience by providing fast, reliable content delivery to users regardless of their location. This can help to reduce latency and improve the overall user experience.
- 

Features of MetaCDN

1. **Global presence:** The business application of any user gets massive amount of CDN locations which is not possible with one single CDN provider.
 2. **Fastest content delivery:** MetaCDN always selects the best optimal server for individual users. If there are multiple CDN providers in one region, users will always get the content from the fastest one within that region.
 3. **Always uptime:** MetaCDN gives guarantee of 100% service uptime; because if one CDN network goes down, MetaCDN immediately routes the traffic through another provider.
- 

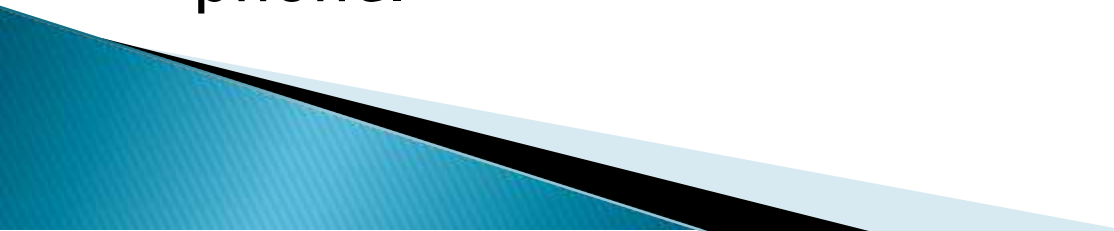
Mobile Cloud Computing (MCC)

- ▶ Mobile Cloud Computing (MCC) is a concept related to cloud computing and it brings services such as on demand access and no on-premise software.
 - ▶ Mobile cloud computing uses network capabilities alone to deliver the desired service to customers and charges for their use. It cloud permit the user to reserve network bandwidth, thus confirming timely delivery of information.
- 

Mobile Cloud Computing (MCC)

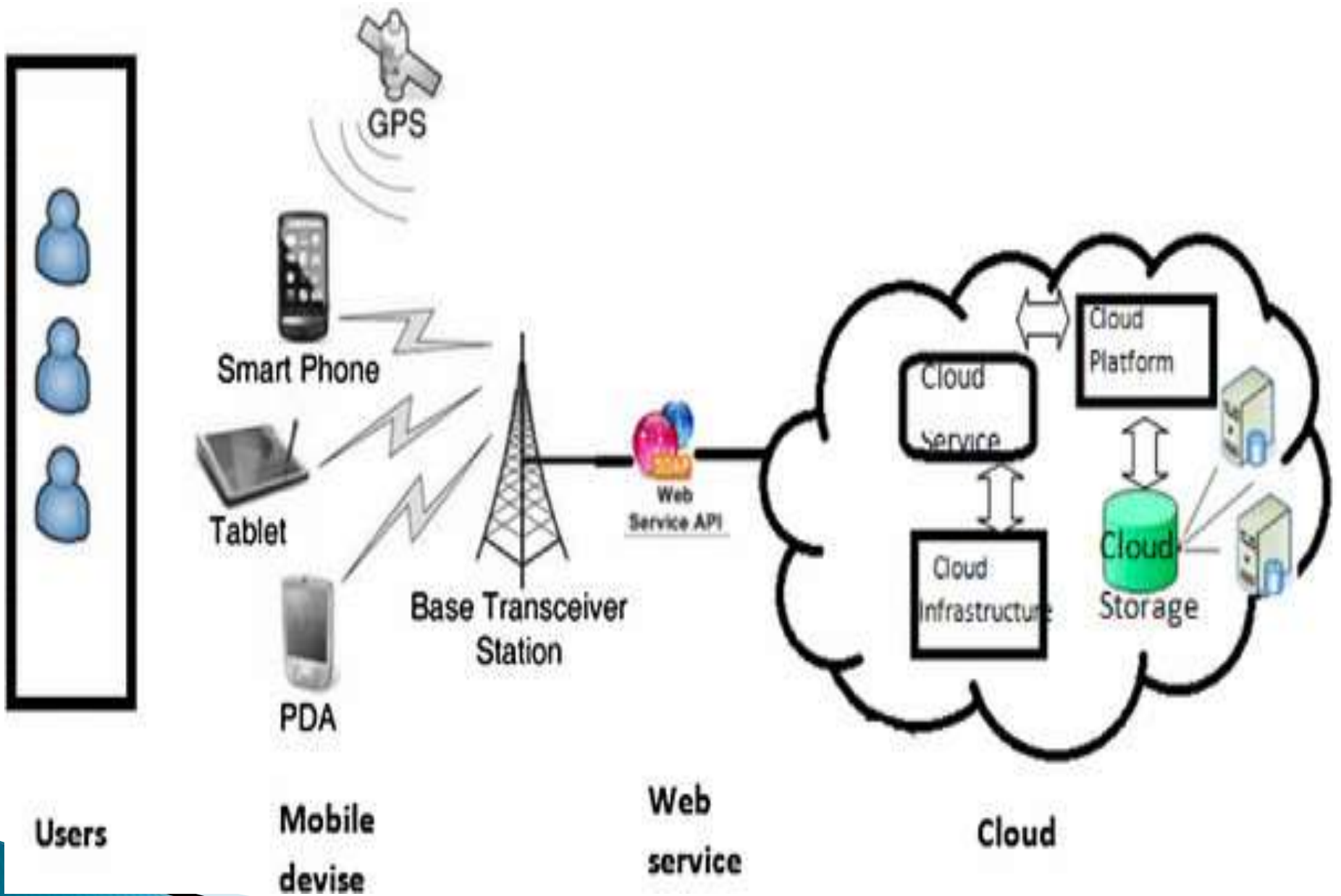
Mobile Cloud Computing (MCC) is a new paradigm for mobile applications where data processing and storage are moved from the mobile device to cloud. The mobile world is dependent on two factors: a) network stability, b) handset availability

Because mobile phones do not have adequate processing power to support huge amounts of data, cloud computing seems to be the ideal solution for these mobile phone users. Cloud computing allows these mobile phone users to have the same amount of data access as 'smart' phone users, and have their data stored into phone.



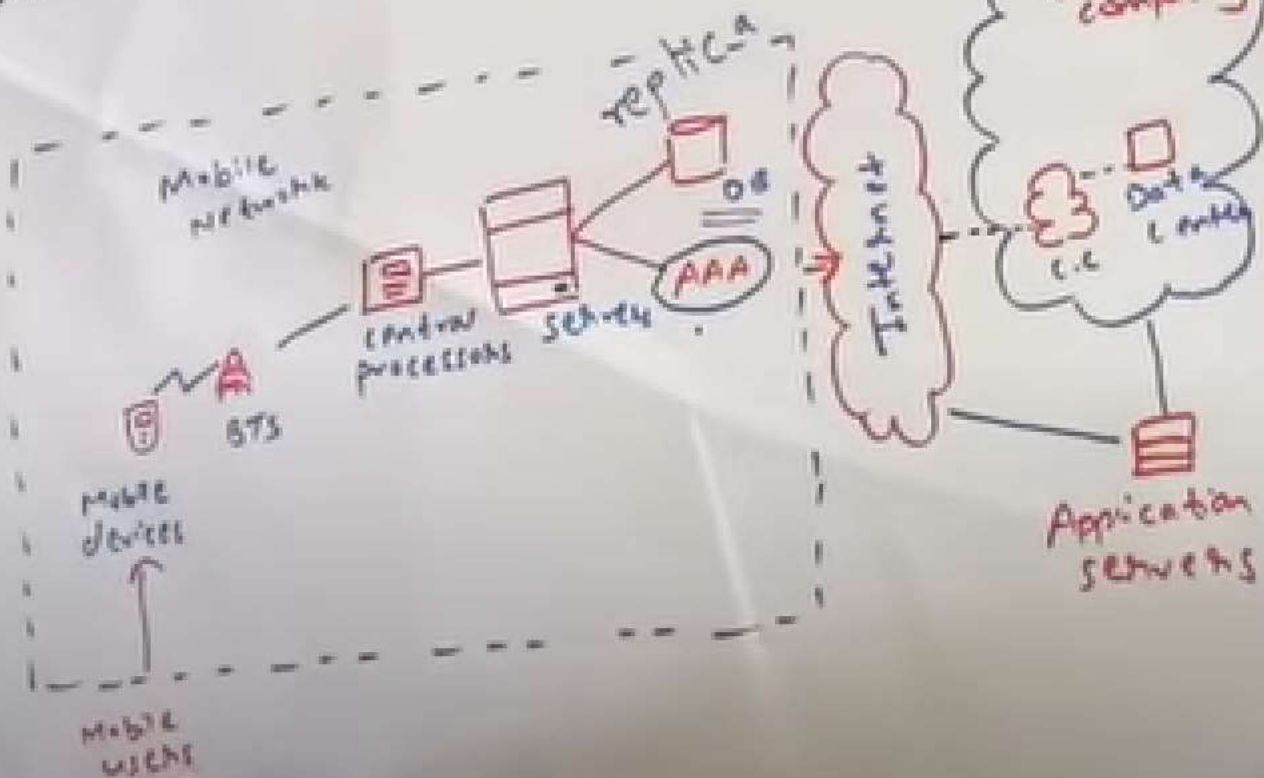


www.educba.com

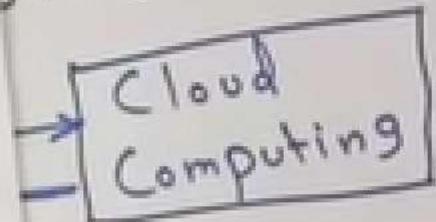


Mobile cloud computing

Architecture



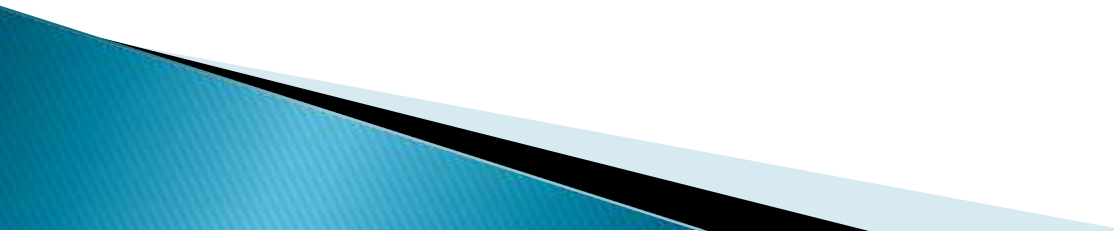
Cloud computing



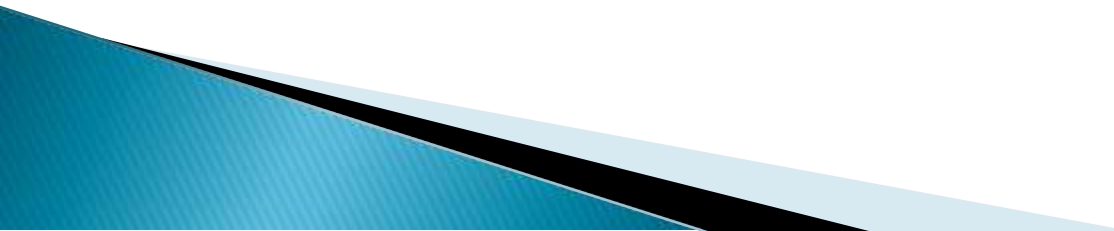
Authentication
Authorization
Accounting

of
ming

Why mobile Cloud computing?

1. **Limited processing:** Mobile phones do not have adequate processing power or memory to support huge amounts of data.
 2. **Loss of connection:** Due to the mobility of the clients and the wireless network setup, mobile clients can be removed temporarily from the previous connected network and may enter another network; therefore, service requests or responses may fail to be delivered to their destination.
 3. **Bandwidth / Latency:** Cell networks have inadequate bandwidth and are often billed on the basis of the amount of data transferred.
- 

InterCloud Issues: A Grid of Clouds

- ▶ InterCloud is a global “cloud of clouds” which describes a service pattern and agreement among cloud providers to build interconnected cloud services for providing flexibility and enhanced experience to users. The situation when more cloud providers work and operate together is called a grid of clouds.
 - ▶ The key benefit of InterCloud is that it solves cloud interoperability issues. The vendor lock-in problem, where a user becomes dependent only on a single cloud service provider, can be solved with the help of interCloud.
- 

Cloud providers face some specific challenges when trying to implement InterCloud. InterCloud can be implemented successfully once the following challenges are solved:

1. **Lack of standards:** Because cloud computing standards are evolving, and research is ongoing on various developing standards, cloud resources such as virtual machine provisioning, object and block storage cannot be standardized for all cloud providers in InterCloud. Some common naming conventions, addressing, messaging and identity management are required to solve this.
2. **API translation:** There should be common interface for all cloud providers that are part of InterCloud. This common interface should be responsible for API or other service request translation between two providers.
3. **Security:** following are some possible security-related threats when InterCloud starts working:
 - Task and services migration from one cloud provider to another provider.
 - The question about who should monitor the common administration among all clouds.
 - Managing public key infrastructure of InterCloud.
 - Agreement on common encryption and decryption protocol for all cloud providers.

The image features a central white rectangular card with rounded corners and a black border. The card is set against a light blue background. In the top left corner, there is a small orange hexagonal object. To the left of the card, there are three yellow chevron-like shapes pointing right. In the top right corner, there is a blue double-headed curved arrow. In the bottom right corner, there is a blue pen with a silver clip. In the bottom left corner, there is a yellow rectangular object. In the bottom center, there is a green wavy line. In the top right corner, there is a white document with horizontal lines. The card itself has the word "Unit" in a large, bold, blue font, followed by a horizontal line, the number "4" in a large, bold, blue font, another horizontal line, and the text "Economics in Cloud" in a smaller, black font.

Unit

4

Economics in Cloud

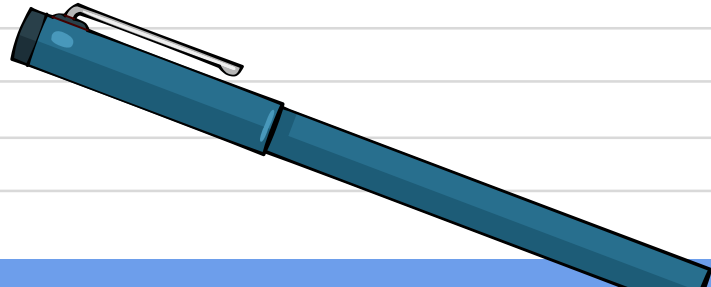
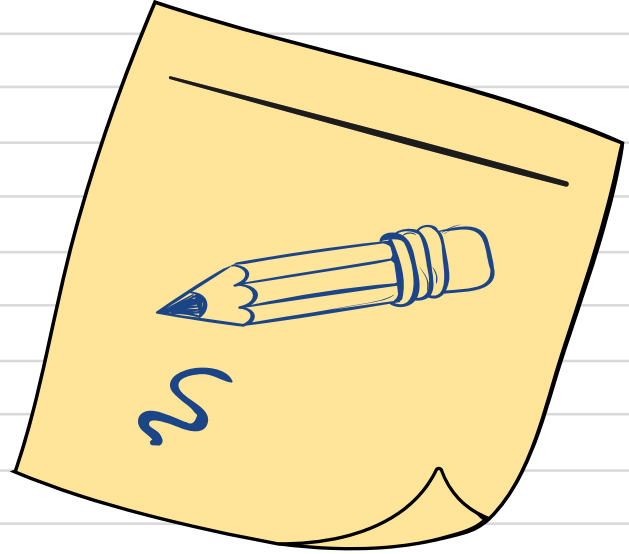
Contents



- **Cloud Economics :**
 - Developing an Economic Strategy
 - Exploring the Costs
 - Laws of cloudonomics
 - Cost estimation

Cloud economics!

Cloud economics is the study of cloud computing costs and benefits and the economic principles that underpin them.





Developing an Economic Strategy

- Reducing operating costs and optimizing IT environments are pivotal to understanding and being able to compare the cost models behind provisioning on-premise and cloud-based environments.
- The pricing structures used by public clouds are typically based on utility-centric pay-per-usage models, enabling organizations to avoid up-front infrastructure investments.
- These models need to be assessed against the financial implications of on-premise infrastructure investments and associated total cost-of-ownership commitments





In detail...



1. Visibility on Cloud Inventory

According to a recent survey of IT professionals, 75% report, they lack visibility of their cloud resources. This lack of visibility into resources in the cloud can lead to poor management of those resources. Effective cloud cost management begins with an in-depth analysis of your entire infrastructure. And if some resources in the cloud are going unused due to lack of awareness, but the organization is still paying for them, cloud costs will climb unnecessarily – and cut into the infrastructure savings and other financial benefits the cloud can bring. Admins who have access to a single pane of glass and detailed Resource Dashboards are equipped to better organize, manage, and optimize that ecosystem across all accounts, clouds, departments, and teams.

2. Cost Analytics

Complete visibility on the cloud services used, the actual usage patterns and trends is the first step. No matter your cloud environment, in addition to tracking what you have spent, it is important to project what you will be spending. You need consolidated as well granular details in the form of interactive graphical and tabular reports across multiple dimensions, time frames in a multi-cloud environment to correlate data for analysis and reporting against business objectives.

In detail...



3. Role Based Access

Permit users to actively manage the infrastructure after setting an Enterprise-wide mechanism that clearly defines permissions and accessibility within the platform. Limit the data and actions visible to users by organizations and roles and identify who launched, terminated, or changed infrastructure, and what they did to take corrective action and control costs.

4. Controlled Stack Templates

A crucial characteristic of any DevOps team is to enable teams more autonomy over-provisioning resources without the red tape and extensive time delay of traditional IT environments. If it is implemented without the accompanying automation and process best practices, decentralized teams have the potential to produce convoluted and non-standard security rules, configurations, storage volumes, etc. and therefore drive up costs. Using predefined stack templates, Administrators can bake in security, network, and instance family/size configurations, so that the process of deploying instances is not only faster but aligned with the Departmental user's roles and privileges and ensures only specific Resources are provisioned.

In detail...



5. Automated Alerts and Notifications

Stay on top of day-to-day changes in your environment, and participate in the critical decision by sharing standard and custom built reports with details on cost, usage, performance with stakeholders. Automated alerts and notifications about authorization failures, budget overruns, cost spikes, untagged infrastructure result in increased visibility and accountability.

6. Policy Based Governance

Use cloud-based governance tools to track cloud usage and costs and alert administrators when the total usage for the account is greater than a certain value or when the total usage for a vendor specific product is greater than a certain value helps control cost. Schedule operational hours to automatically shut down & start virtual machines, and automated events that alert administrators on volumes that have been disassociated from Virtual machines (standalone VMs) for more than a set number of days. In short, use integrated data sources, metadata, or custom tags to define a set of rules that lead to improved cost management, reporting and optimization.

In detail...



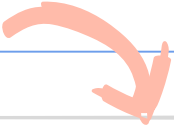

7. Budgets

Define and allocate budgets for Departments, cost centers, projects and ensure approval mechanisms to avoid cloud cost overrun by sending out alerts when thresholds are breached. Use the Showback report to chargeback Departments for their cloud usage and limit the cloud cost and use of resources. This alignment of cost with value ensures the anticipated business benefit once the cloud resources are in production

Exploring The costs

Up-Front Costs

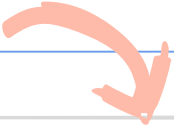

Up-front costs are associated with the initial investments that organizations need to make in order to fund the IT resources they intend to use. This includes both the costs associated with obtaining the IT resources, as well as expenses required to deploy and administer them.

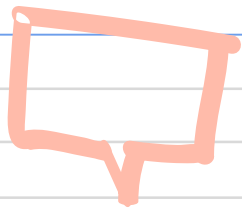
- 
- Up-front costs for the purchase and deployment of on-premise IT resources tend to be high. Examples of up-front costs for on-premise environments can include hardware, software, and the labor required for deployment.
 - Up-front costs for the leasing of cloud-based IT resources tend to be low. Examples of up-front costs for cloud-based environments can include the labor costs required to assess and set up a cloud environment.
- 

On-going Costs

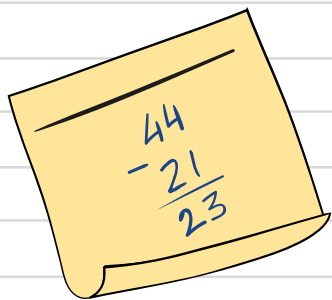
On-going costs represent the expenses required by an organization to run and maintain IT resources it uses.


- On-going costs for the operation of on-premise IT resources can vary. Examples include licensing fees, electricity, insurance, and labor.

- 
- On-going costs for the operation of cloud-based IT resources can also vary, but often exceed the on-going costs of on-premise IT resources (especially over a longer period of time). Examples include virtual hardware leasing fees, bandwidth usage fees, licensing fees, and labor.
- 

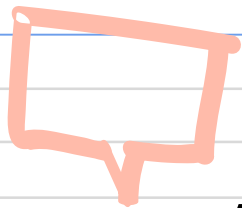


Laws of clouconomics

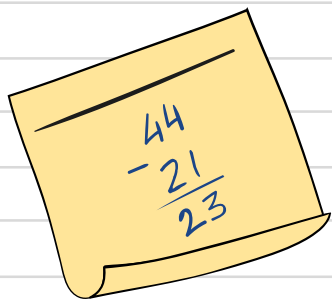





**Utility services
cost less even
though they
cost more.**



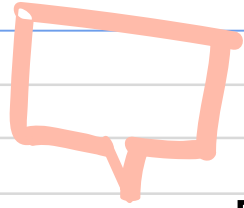
Although utilities cost more when they are used, they cost nothing when they are not. Consequently, customers save money by replacing fixed infrastructure with Clouds when workloads are spiky, specifically when the peak-to-average ratio is greater than the utility premium.



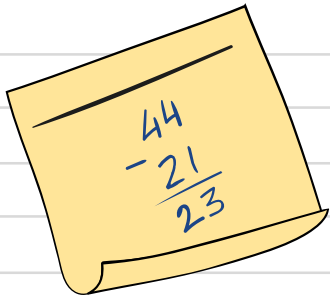


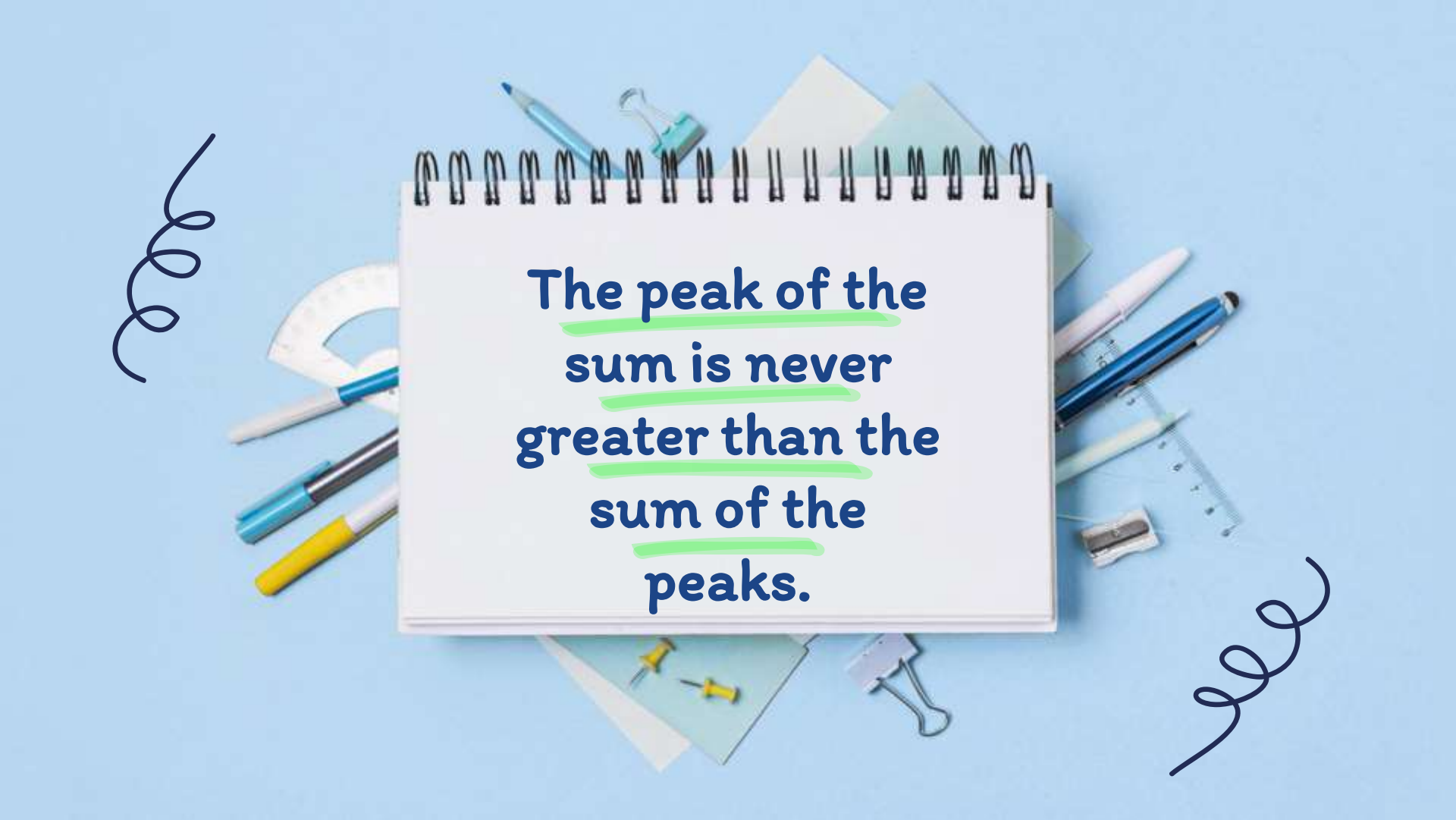
**On-demand
trumps
forecasting.**

—

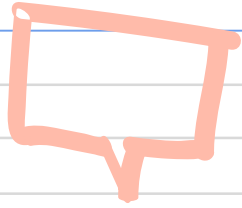


Forecasting is often wrong, the ability to up and down scale to meet unpredictable demand spikes allows for revenue and cost optimalities.



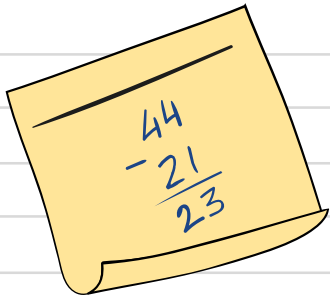



**The peak of the
sum is never
greater than the
sum of the
peaks.**



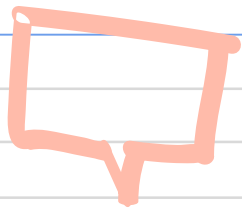
Enterprises deploy capacity to handle their peak demands. Under this strategy, the total capacity deployed is the sum of these individual peaks.

However, since clouds can reallocate resources across many enterprises with different peak periods, a cloud needs to deploy less capacity.

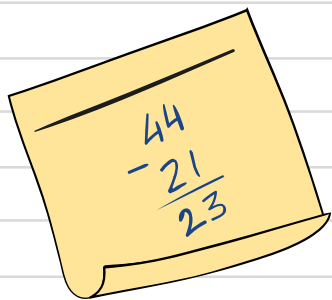





Aggregate
demand is
smoother than
individual.

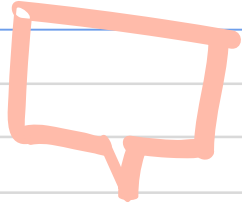


Aggregating demand from multiple customers tends to smooth out variation. Therefore, Clouds get higher utilization, enabling better economics.

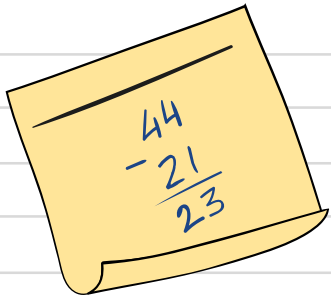





**Average unit
costs are
reduced.**

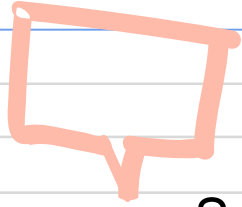


They are reduced by distributing fixed costs over more units of output. Larger cloud providers can therefore achieve economies of scale.

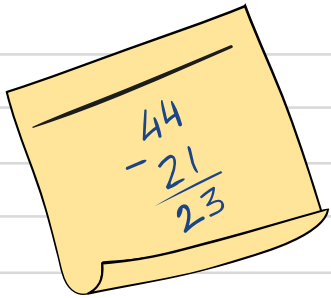





Superiority in
numbers.

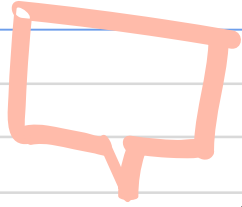


Superiority in numbers is the most important factor in the result of a combat. Service providers have the scale to fight rogue attacks.

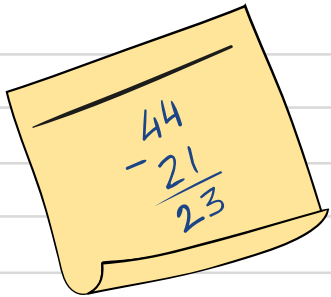





**Space-time is a
continuum.**

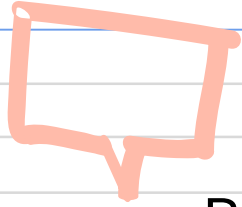


Organizations derive competitive advantage from responding to changing business conditions faster than the competition. With Cloud scalability, for the same cost, a business can accelerate its information processing and decision-making.

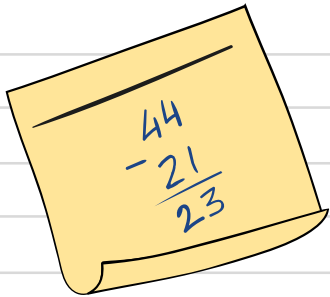





**Dispersion is
the inverse
square of
latency.**

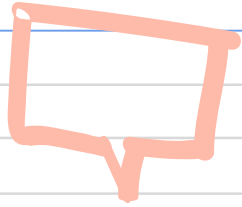


Reduced latency is increasingly essential to modern applications. A Cloud Computing provider is able to provide more nodes, and hence reduced latency, than an enterprise would want to deploy.

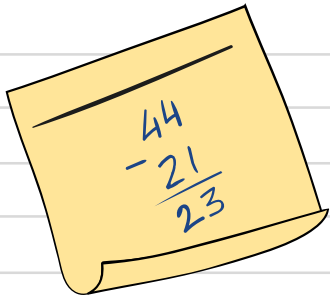





**Don't put all
your eggs in one
basket.**

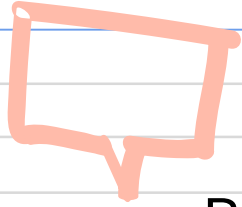


A data center is a very large object. Private data centers tend to remain in locations for reasons such as being where the company was founded, or where they got a good deal on property or a lease. A Cloud service provider can locate greenfield sites optimally and without such limits of legacy logic.

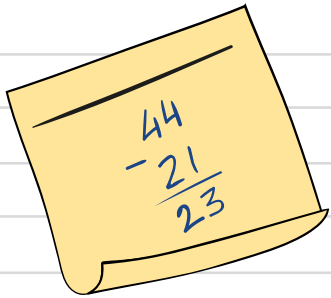




**An object at
rest tends to
stay at rest.**



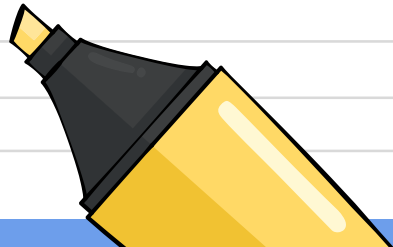
Reduced latency is increasingly essential to modern applications. A Cloud Computing provider is able to provide more nodes, and hence reduced latency, than an enterprise would want to deploy.





Cloud Cost Estimator

It helps to
determine how
much will it cost
you, if you happen
to purchase...





An example Oracle cloud Cost Estimation Tool...

Cost Estimator

[Selecting a Payment Plan](#)

Monthly Cost *
\$ 0 /mo

[Start for Free](#)

Core Infrastructure

USD - US Dollar (\$)

Compute VM

A fully scalable multi-tenant Virtual Compute environment to run applications with uncompromised performance, control and built-in resiliency.

Add

Compute BM

A fully scalable multi-tenant Bare Metal compute environment to run applications with predictable, high performance and built-in resiliency.

Add

Compute GPU

Designed for hardware-accelerated workloads. GPU shapes include Intel or AMD CPUs and NVIDIA graphics processors.

Add

Networking

OCI networking services offer Layer 2 isolation of your tenancy to prevent 'noisy neighbors' from disrupting your workloads and offers highly customizable virtual cloud networks (VCN) and connectivity services that extend your IT infrastructure without the massive network egress services common in public clouds.

Add

There's one for google too...

Google Cloud Pricing Calculator

Prices are up to date. Last update: 14-March-2022



COMPUTE
ENGINE



GKE
STANDARD



GKE
AUTOPILOT



BACKUP FOR
GKE



CLOUD RUN



ANTHOS



VERTEX AI
TRAINING

Estimate

Search for a product you are interested in,



Instances

Number of instances *



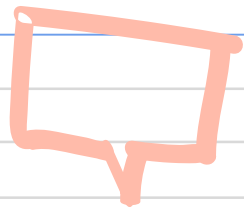
What are these instances for?



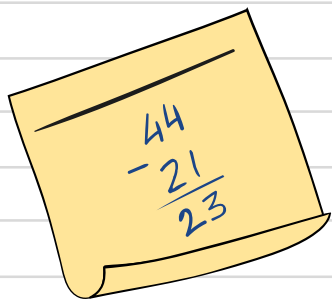
Operating System / Software


Free: Debian, CentOS, CoreOS, Ubuntu or BYOL (Bring Your Own License)





Economics of Cloud





Economics of Cloud Computing is based on the PAY AS YOU GO method. Users/Customers must have to pay only for their way of the usage of the cloud services. It is definitely beneficial for the users. So the Cloud is economically very convenient for all.

Economical background of the cloud is more useful for developers in the following ways:

- Pay as you go model offered by cloud providers.
- Scalable and Simple.

Cloud Computing Allows:

- 1) Reduces the capital costs of infrastructure.**
- 2) Removes the maintenance cost.**
- 3) Removes the administrative cost.**

There are three different **Pricing Strategies** that are introduced by Cloud Computing:

- 1) Tiered Pricing,
- 2) Per-unit Pricing,
- 3) Subscription-based Pricing.

1) Tiered Pricing: Cloud Services are offered in the various tiers. Each tier offers to fix service agreements at a specific cost.

Amazon EC2 uses this kind of pricing.

2) Per-unit Pricing: The model is based upon the unit-specific service concept. Data transfer and memory allocation include in this model for specific units. GoGrid uses this kind of pricing in terms of RAM/hour.

3) Subscription-based Pricing: In this model, users are paying periodic subscription fees for the usage of the software.