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Generated on: 9/7/2025 7:56:52 PM

User

ppt above system Design definiiton and scaling and its types and load balancing and its alogotithm and messaging queue and cahing like distribued caching all above with eg and advantages and disadvantages and if you have example images then atht also or images links

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Certainly! Below is a structured outline and content for a PowerPoint presentation covering:

- System Design Definition
- Scaling and its Types
- Load Balancing and its Algorithms
- Messaging Queues
- Caching (including Distributed Caching)

Each section includes definitions, examples, advantages, disadvantages, and suggestions for images. You can use this content to create slides.

Slide 1: Title Slide

System Design Concepts: Scaling, Load Balancing, Messaging Queues, and Caching

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Slide 2: System Design Definition

Definition: System Design is the process of defining the architecture, components, modules, interfaces, and data for a system to satisfy specified requirements.

Example: Designing a social media platform like Twitter involves deciding how to store tweets, handle user requests, scale the system, etc.

Advantages:

- Helps build scalable, maintainable systems
- Ensures system meets requirements

- Facilitates communication among stakeholders

Disadvantages:

- Can be complex and time-consuming
- Requires experience and knowledge

Image Suggestion:

- Diagram of system components (client, server, database, cache)

Slide 3: Scaling and Its Types

Definition: Scaling is the process of increasing a system's capacity to handle more load.

Types of Scaling:

- 1. Vertical Scaling (Scaling Up): Increasing resources (CPU, RAM) of a single machine.

- Example: Upgrading a server from 8GB RAM to 32GB RAM. - Advantages: Simple to implement, no code changes. - Disadvantages: Limited by hardware capacity, single point of failure.

- 2. Horizontal Scaling (Scaling Out): Adding more machines to the system.

- Example: Adding more web servers behind a load balancer. - Advantages: High availability, fault tolerance, virtually unlimited scaling. - Disadvantages: More complex, requires distributed system design.

Image Suggestion:

- Diagram showing vertical scaling (single server upgrade) vs horizontal scaling (multiple servers).

Slide 4: Load Balancing

Definition: Load Balancing distributes incoming network traffic across multiple servers to ensure no single server is overwhelmed.

Advantages:

- Improves responsiveness

- Increases availability and reliability
- Enables horizontal scaling

Disadvantages:

- Adds complexity
- Potential single point of failure if load balancer is not redundant

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Slide 5: Load Balancing Algorithms

- 1. Round Robin: Distributes requests sequentially across servers.

- Example: Server1 → Server2 → Server3 → Server1 → ... - Advantages: Simple, fair distribution. - Disadvantages: Does not consider server load.

- 2. Least Connections: Sends request to the server with the fewest active connections.

- Advantages: Better for uneven load. - Disadvantages: Requires tracking connections.

- 3. IP Hash: Uses client's IP address to determine server.

- Advantages: Ensures session persistence. - Disadvantages: Uneven distribution if IPs are skewed.

Image Suggestion:

- Diagram showing request distribution using different algorithms.

Slide 6: Messaging Queues

Definition: A messaging queue is a communication method where messages are stored in a queue until processed by consumers.

Example: Order processing system where orders are placed in a queue and processed asynchronously.

Advantages:

- Decouples components
- Enables asynchronous processing
- Improves system resilience

Disadvantages:

- Adds latency
- Requires message queue management

Popular MQ Systems: RabbitMQ, Apache Kafka, AWS SQS

Image Suggestion:

- Diagram showing producer → message queue → consumer.

Slide 7: Caching

Definition: Caching stores frequently accessed data temporarily to reduce latency and load on the main data source.

Types:

- In-memory cache: e.g., Redis, Memcached
- Distributed cache: Cache shared across multiple servers

Example: Caching user session data to avoid repeated database queries.

Advantages:

- Faster data access
- Reduces database load
- Improves user experience

Disadvantages:

- Cache invalidation complexity
- Stale data risk

Slide 8: Distributed Caching

Definition: Distributed caching spreads cache data across multiple nodes to handle large data and provide fault tolerance.

Example: Using Redis Cluster to cache product catalog data in an e-commerce site.

Advantages:

- Scalability
- High availability
- Fault tolerance

Disadvantages:

- More complex to implement
- Network overhead

Image Suggestion:

- Diagram of distributed cache nodes sharing data.

Slide 9: Summary

Concept	Advantages	Disadvantages
System Design	Scalable, maintainable systems	Complex, time-consuming
Vertical Scaling	Simple, no code changes	Limited capacity, single point
Horizontal Scaling	High availability, scalable	Complex, distributed design
Load Balancing	Improves availability	Adds complexity
Messaging Queue	Decouples components, async	Adds latency
Caching	Faster access, reduces DB load	Cache invalidation issues
Distributed Cache	Scalable, fault tolerant	Complex, network overhead

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Slide 10: References & Image Sources

- System Design Primer: https://github.com/donnemartin/system-design-primer
- Load Balancing Algorithms: https://www.nginx.com/resources/glossary/load-balancing/
- Messaging Queues: https://www.rabbitmq.com/tutorials/tutorial-one-python.html
- Caching: https://redis.io/topics/introduction
- Images: Use diagrams from above links or create custom diagrams using tools like draw.io or Lucidchart.

If you want, I can also provide direct image links or help create diagrams in text form. Let me know!

User

System Design

System Design is the process of designing the architecture, components, and interfaces for a system so that it meets the end-user requirements.

Why Learn System Design? System design is important for anyone who wants to build a robust, scalable, and efficient software application. Whether you are building a small-scale application or a large one, understanding system design allows you to architect solutions that can handle real-world complexities.

Scalability

Mobile -> request -> server -> response client and server Single user no problem if request get from 1000 user it will handle then now 100000 user sent to server Issue came Scaling

Scaling

if 1 user using that server will give response and if 100000 user using that time alose the give response with same performance and sability will provide that server

2 types of Scaling : horizontal scaling and vertical scaling

Server is a system if that system have move ram it will handle more request

eg if mobile phone have 2 gb ram it handle 5 applications at same time and it will lage but if system have 8 gb it will handle easly same comcept for server also

we need to buy server with concept but AWS server is cost high so we cost effective and same need to handle all the server so we use Scaling Concepts

VS – eg I share server link to friends it will run1000 but now 5000 users need to increase ram and storeage vg – 2 gm 20gm ssd to 4gb ram and 40gb ssd we can improve – upgrade machine.

HS- we can buy 2 system same 2 gm and 20 ssd

we can extend the machine .

Dis Advantages : VS - if I extended system if the user came 50000 next user reduce but over all user high but daily user less so we want only 2gm ram and we can’t reduce system ram and storage. We pay more cost eg: 1 lakhs user We can’t predict the user HS – we can buy same ram with ssd 2 same if the user reduce we can remove the system it reduce AWS Cost

Company prefer both based on requirement small company HS

VS – same server for 10000 user same database HS Muliple server Communication with help of Load Balancer Load Balancer will handle muliple request and split to server

it have separate cost we user both but must have for HS

We don't need for VS single server

HS – data inconsistency occur VS – data consistency

we have handle file releated HS sent request to free server and next request will sent another server

but in VS Same server it will not affect

initially HS and VS later

HS for public server and VS for private user

Vs 92 gb maximum but hs we can use with split

Load Balancing Eg : Traffic police

Handle for too many request

Request 10000 server and response not handle without Load Balancer it will fail Request -> Load Balancer -> server Server have multiple instance so load balance will decide which server is free and sent to then For these they have algorithms 1. Round Rober -> line by line they sent the request to server 2. A least request server -> check which server have lowest request have to sent 3. Least no of connections -> check request which is process quickly Eg : upload a video it will take time like that it will check which fast Profile view simple so fast, like edit, upload

They have consistent hashing Request id dived by server and sent to them Time and space complex it will check 50000 have 5 server it will take time so it add another instance 1. Reduce overtime 2. 2.scalable 3. Redendence 4. Flexiabilty Api gate way vs load balancer Api gate way -> load balancer

Message queue :

based on this add or chnages in above

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Certainly! Below is a refined and organized version of your content with added clarity, formatting, and some LaTeX math formatting where applicable. This can be used directly for your PowerPoint slides or notes.

Slide 1: System Design

Definition: System Design is the process of designing the architecture, components, and interfaces for a system so that it meets the end-user requirements.

Slide 2: Why Learn System Design?

- Enables building robust, scalable, and efficient software applications.
- Helps architect solutions that handle real-world complexities.
- Useful for both small-scale and large-scale applications.

Slide 3: Scalability Concept

- Typical flow:

Mobile → Request → Server → Response

- For a single user, the server handles requests easily.
- But when 1000 users or 100,000 users send requests simultaneously, the server faces challenges.
- This is where scaling becomes important.

Slide 4: What is Scaling?

- Scaling means the system can handle increased load without degrading performance or stability.
- Example:

- If 1 user uses the server, it responds quickly. - If 100,000 users use it simultaneously, the server should still respond efficiently.

Slide 5: Types of Scaling

1. Vertical Scaling (VS) - Scaling Up

- Increase resources (RAM, CPU, storage) of a single server.
- Example:

- Mobile phone with 2GB RAM can run 5 apps but lags. - Mobile phone with 8GB RAM runs apps smoothly.

- Server example: Upgrade from 2GB RAM & 20GB SSD to 4GB RAM & 40GB SSD.

2. Horizontal Scaling (HS) - Scaling Out

- Add more servers with similar specs.
- Example: Buy 2 servers each with 2GB RAM & 20GB SSD instead of upgrading one server.

Slide 6: Vertical vs Horizontal Scaling

Aspect	**Vertical Scaling (VS)**	**Horizontal Scaling (HS)**
Cost	Higher cost for upgrades	Cost-effective by adding/removing servers
Flexibility	Limited, cannot reduce resources easily	Flexible, can add/remove servers as needed
Performance	Single server bottleneck	Distributed load, better fault tolerance
Data Consistency	Easier to maintain	More complex due to multiple servers
Use Case	Small user base, private/internal systems	Large user base, public-facing systems

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Slide 7: Load Balancing

- Acts like a traffic police for incoming requests.
- Distributes requests across multiple servers to avoid overload.
- Flow:

Request → Load Balancer → Multiple Servers → Response

Slide 8: Load Balancing Algorithms

- 1. Round Robin:

Requests are distributed sequentially to each server. Example: Server1 → Server2 → Server3 → Server1 → ...

- 2. Least Request:

Sends request to the server with the fewest active requests.

- 3. Least Number of Connections:

Chooses the server processing requests the fastest (good for long tasks like video upload).

- 4. Consistent Hashing:

Uses a hash function on request ID to assign a server, useful for session persistence.

Slide 9: Load Balancer Benefits

- Reduces server overload.
- Improves scalability.
- Provides redundancy and fault tolerance.
- Adds flexibility in managing server resources.

Slide 10: API Gateway vs Load Balancer

Feature	API Gateway	Load Balancer
Primary Role	Manages API requests, routing, security	Distributes network traffic across servers
Handles	Authentication, rate limiting, caching	Load distribution, health checks
Use Case	Microservices architecture	Scaling web servers

Slide 11: Messaging Queue

- Definition: A messaging queue stores messages until they are processed by consumers asynchronously.
- Use Case: Order processing, task scheduling, decoupling services.

Slide 12: Messaging Queue Advantages

- Decouples producers and consumers.
- Enables asynchronous processing.
- Improves system resilience and scalability.

Slide 13: Summary Table

Concept	Advantages	Disadvantages
Vertical Scaling	Simple, no code changes	Limited capacity, costly upgrades
Horizontal Scaling	Scalable, fault tolerant	Complex, data consistency issues
Load Balancing	Efficient request distribution	Adds complexity
Messaging Queue	Decouples components, async	Adds latency

Slide 14: Example Diagram Suggestions

- Scaling: Show vertical scaling (single server upgrade) vs horizontal scaling (multiple servers).
- Load Balancing: Show requests distributed by load balancer to multiple servers.
- Messaging Queue: Show producer → message queue → consumer flow.

If you want, I can help generate simple ASCII diagrams or provide links to free diagram tools like draw.io or Lucidchart.

If you want me to generate a sample diagram or add more details on any topic, please let me know!