Netflix System design

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

Functional Requirements:

- Content upload (videos, shows)
- User streaming and interaction (like, dislike, share)
- Personalized video recommendations

Non-Functional Requirements:

- High availability with minimal latency
- Scalability and efficiency to handle millions of users

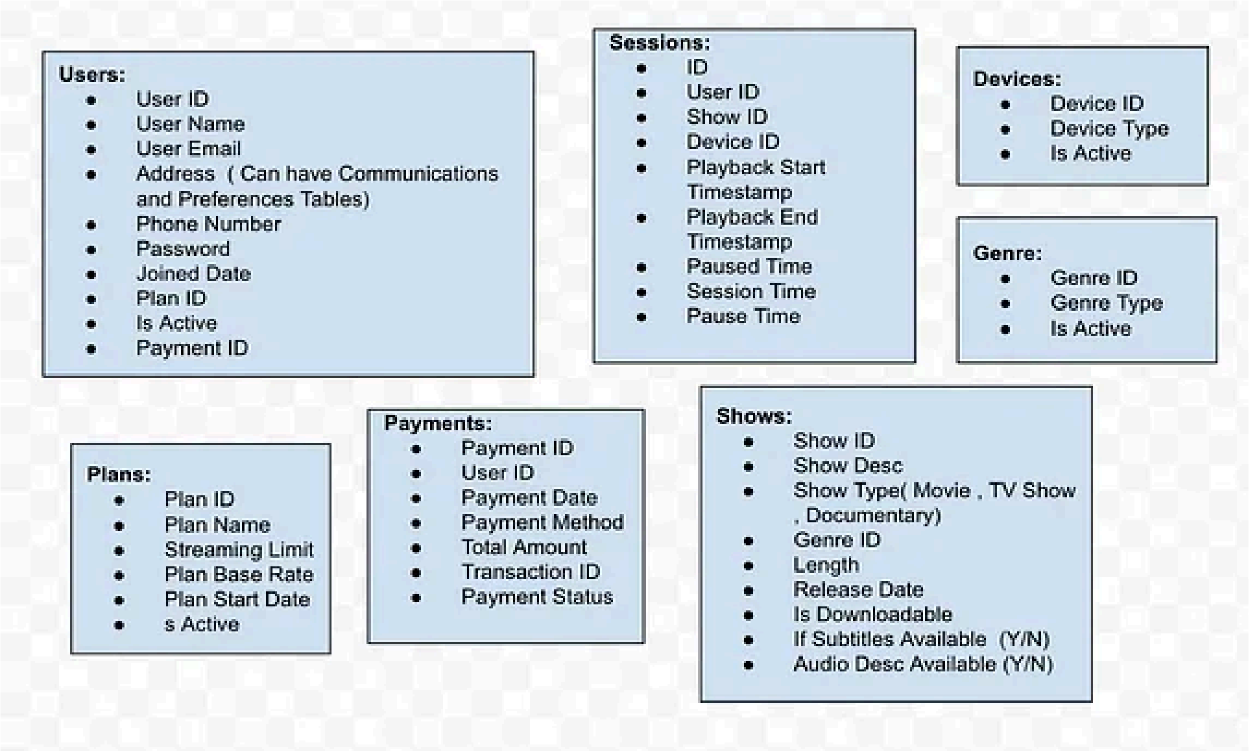
System Design Principles:

- Break down the problem into smaller components (services, features).
- Clearly define the system's goal and avoid overcomplication.
- Make reasonable assumptions about scale and usage (users, requests, data).
- Design data models and data flow between components.
- Employ high-level and low-level design approaches.

Assumptions:

- 1 billion users, 200 million daily active users
- 1 million videos, 1,000 new uploads daily
- 1 billion requests per day (12,000 per second)

Data Storage and Management:



Users:

- User ID
- User Name
- User Email
- Address (Can have Communications and Preferences Tables)
- Phone Number
- Password
- Joined Date
- Plan ID
- Is Active
- Payment ID

Sessions:

- ID
- User ID
- Show ID
- Device ID
- Playback Start Timestamp
- Playback End Timestamp
- Paused Time
- Session Time
- Pause Time

Devices:

- Device ID
- Device Type
- Is Active

Genre:

- Genre ID
- Genre Type
- Is Active

Plans:

- Plan ID
- Plan Name
- Streaming Limit
- Plan Base Rate
- Plan Start Date
- s Active

Payments:

- Payment ID
- User ID
- Payment Date
- Payment Method
- Total Amount
- Transaction ID
- Payment Status

Shows:

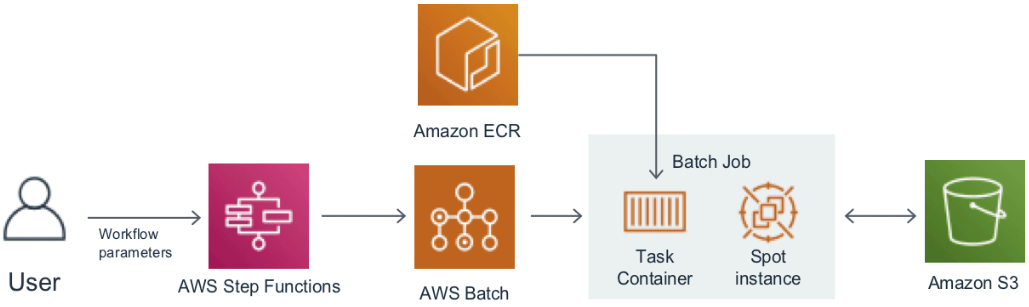
- Show ID
- Show Desc
- Show Type(Movie , TV Show , Documentary)
- Genre ID
- Length
- Release Date
- Is Downloadable
- If Subtitles Available (Y/N)
- Audio Desc Available (Y/N)

- User data (name, email, location, etc.)
- User interaction data (video history, ratings, etc.)
- Video data (ID, genre, cast, release year, stream URL, etc.)
- PostgreSQL for structured data (user, video)
- NoSQL database (Cassandra) for flexible schema (interactions)
- Data lake/warehouse (S3) for storing raw and preprocessed data

Horizontal Scaling	Vertical Scaling
When additional machines are added to the existing system to meet the higher expectation, it is known as horizontal scaling.	When new resources are added in the existing system (increasing RAM, CPU) to meet the expectation, it is known as vertical scaling
It is easier to upgrade.	It is harder to upgrade and may involve downtime.
It is difficult to implement	It is easy to implement
It is costlier, as new server racks comprise a lot of resources	It is cheaper as we need to just add new resources
Cassandra, MongoDB, Google Cloud Spanner	MySQL and Amazon RDS

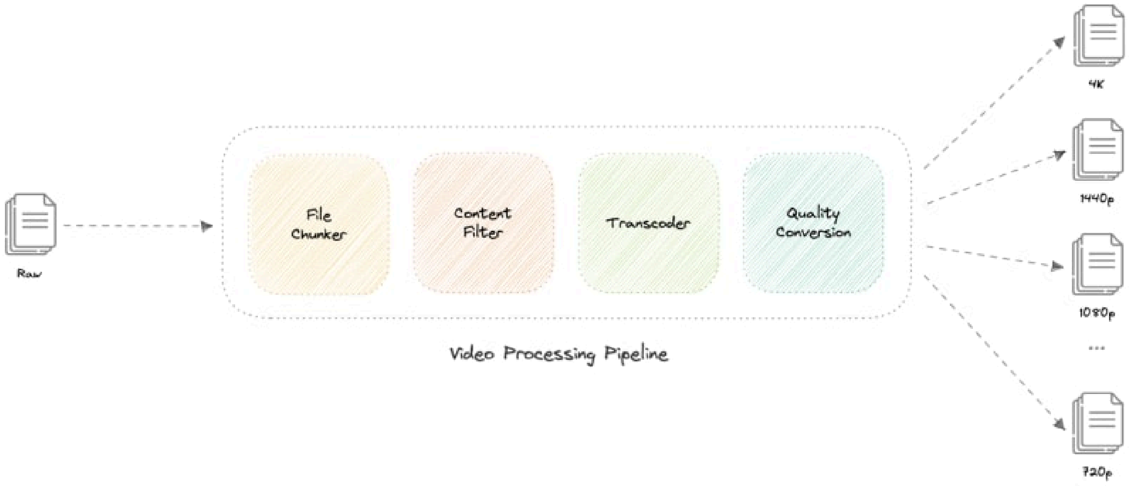
Compute and Orchestration:

Today almost all of Netflix runs on VMs (virtual machines) in AWS. A customer's catalog browsing experience, content recommendation calculations, and payments are all served from AWS.



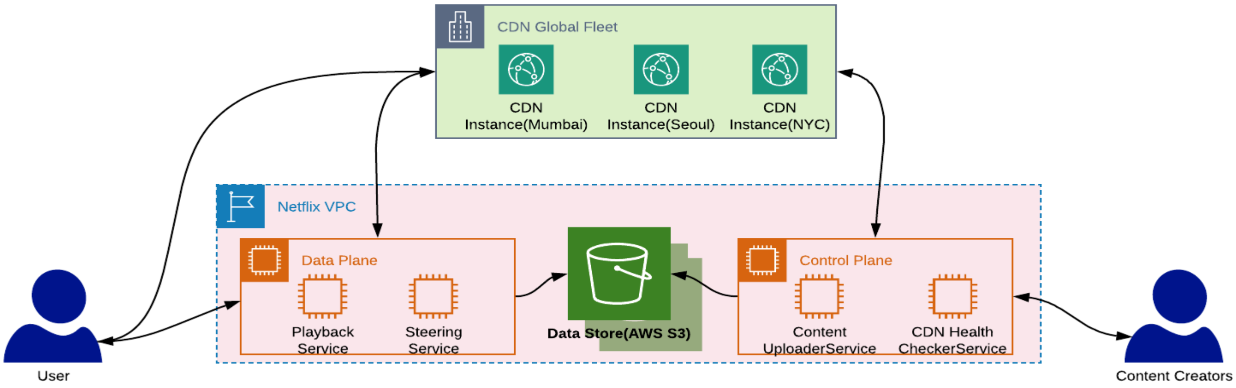
- Cloud-based infrastructure (AWS)
- EC2 virtual machines for core services
- AWS Step Functions and Batch for workflow automation and batch processing
- SageMaker notebooks for experimentation

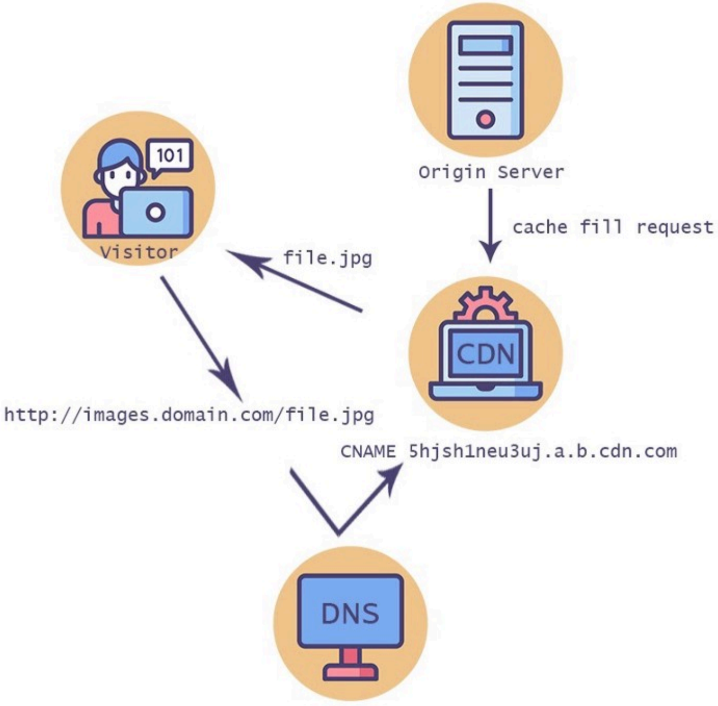
Video Content Storage and Delivery:



- Amazon S3 for scalable and highly available storage
- Pre-encoded videos in multiple formats and resolutions for different devices

- Content Delivery Network (CDN) for geographically distributed content caching (Open Connect program)
- Low latency and high availability through geographically dispersed content replicas




Origin Server
cache fill request
101
Visitor
file.jpg
CDN
http://images.domain.com/file.jpg
CNAME 5hjsh1neu3uj.a.b.cdn.com
DNS

User Interactions and Recommendations:

- User interactions stored in NoSQL database for scalability and flexible schema
- Recommendation systems based on machine learning algorithms (collaborative filtering, content-based filtering, etc.)
- Personalized recommendations based on viewing history, ratings, device, time of day, etc.

To make our system more resilient we can do the following:

- Running multiple instances of each of our services.
- Introducing load balancers between clients, servers, databases, and cache servers.
- Using multiple read replicas for our databases.
- Multiple instances and replicas for our distributed cache.