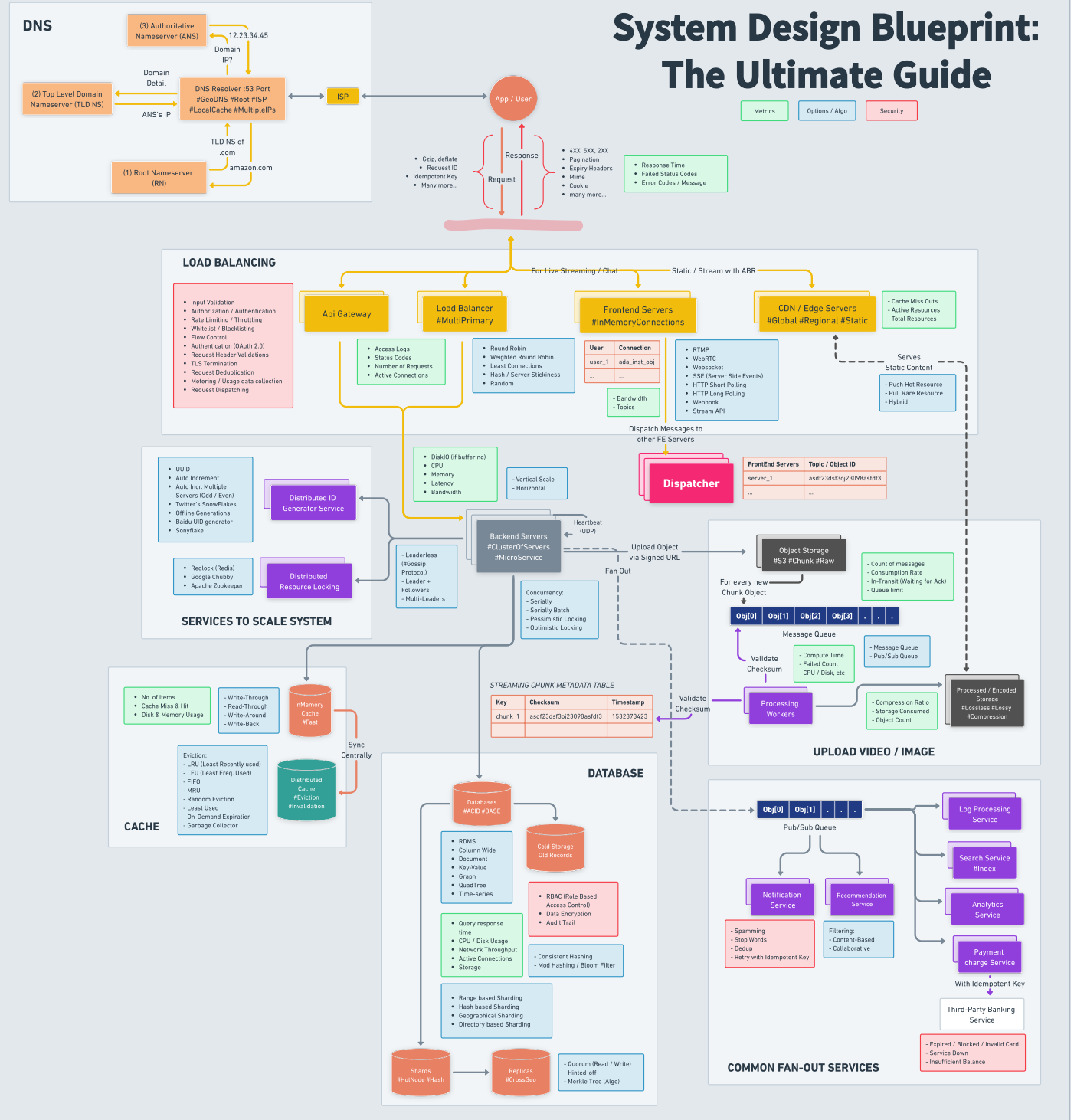# System Design Blueprint: The Ultimate Guide

System Design Blueprint: The Ultimate Guide

Metrics | Options / Algo | Security

DNS

- (3) Authoritative Nameserver (ANS)
- 12.23.34.45
- Domain IP?
- Domain Detail
- (2) Top Level Domain Nameserver (TLD NS)
- DNS Resolver :53 Port #GeoDNS #Root #ISP #LocalCache #MultipleIPs
- ANS's IP
- ISP
- TLD NS of .com
- (1) Root Nameserver (RN)
- amazon.com
- App / User

Request:
- Gzip, deflate
- Request ID
- Idempotent Key
- Many more...

Response:
- 4XX, 5XX, 2XX
- Pagination
- Expiry Headers
- Mime
- Cookie
- many more...

- Response Time
- Failed Status Codes
- Error Codes / Message

LOAD BALANCING

For Live Streaming / Chat | Static / Stream with ABR

- **Api Gateway**
  - Input Validation
  - Authorization / Authentication
  - Rate Limiting / Throttling
  - Whitelist / Blacklisting
  - Flow Control
  - Authentication (OAuth 2.0)
  - Request Header Validations
  - TLS Termination
  - Request Deduplication
  - Metering / Usage data collection
  - Request Dispatching

- **Load Balancer #MultiPrimary**
  - Access Logs
  - Status Codes
  - Number of Requests
  - Active Connections
  - Round Robin
  - Weighted Round Robin
  - Least Connections
  - Hash / Server Stickiness
  - Random

- **Frontend Servers #InMemoryConnections**

User	Connection
user_1	ada_inst_obj
...	...

  - Bandwidth
  - Topics

  - RTMP
  - WebRTC
  - Websocket
  - SSE (Server Side Events)
  - HTTP Short Polling
  - HTTP Long Polling
  - Webhook
  - Stream API

- **CDN / Edge Servers #Global #Regional #Static**
  - Cache Miss Outs
  - Active Resources
  - Total Resources
  - Serves Static Content
  - Push Hot Resource
  - Pull Rare Resource
  - Hybrid

SERVICES TO SCALE SYSTEM

- **Distributed ID Generator Service**
  - UUID
  - Auto Increment
  - Auto Incr. Multiple Servers (Odd / Even)
  - Twitter's SnowFlakes
  - Offline Generations
  - Baidu UID generator
  - Sonyflake

- **Distributed Resource Locking**
  - Redlock (Redis)
  - Google Chubby
  - Apache Zookeeper

- DiskIO (if buffering)
- CPU
- Memory
- Latency
- Bandwidth
- Vertical Scale
- Horizontal

- **Backend Servers #ClusterOfServers #MicroService**
  - Heartbeat (UDP)
  - Leaderless (#Gossip Protocol)
  - Leader + Followers
  - Multi-Leaders

Concurrency:
- Serially
- Serially Batch
- Pessimistic Locking
- Optimistic Locking

Dispatch Messages to other FE Servers

Dispatcher

FrontEnd Servers	Topic / Object ID
server_1	asdf23dsf3oj23098asfdf3
...	...

CACHE

- No. of items
- Cache Miss & Hit
- Disk & Memory Usage
- Write-Through
- Read-Through
- Write-Around
- Write-Back

- **InMemory Cache #Fast**

Eviction:
- LRU (Least Recently used)
- LFU (Least Freq. Used)
- FIFO
- MRU
- Random Eviction
- Least Used
- On-Demand Expiration
- Garbage Collector

- **Distributed Cache #Eviction #Invalidation**
- Sync Centrally

DATABASE

- **Databases #ACID #BASE**
- **Cold Storage Old Records**

- RDMS
- Column Wide
- Document
- Key-Value
- Graph
- QuadTree
- Time-series

- RBAC (Role Based Access Control)
- Data Encryption
- Audit Trail

- Query response time
- CPU / Disk Usage
- Network Throughput
- Active Connections
- Storage

- Consistent Hashing
- Mod Hashing / Bloom Filter

- Range based Sharding
- Hash based Sharding
- Geographical Sharding
- Directory based Sharding

- **Shards #HotNode #Hash**
- **Replicas #CrossGeo**
- Quorum (Read / Write)
- Hinted-off
- Merkle Tree (Algo)

STREAMING CHUNK METADATA TABLE

Key	Checksum	Timestamp
chunk_1	asdf23dsf3oj23098asfdf3	1532873423
...	...	

UPLOAD VIDEO / IMAGE

- Upload Object via Signed URL
- Fan Out

- **Object Storage #S3 #Chunk #Raw**
  - Count of messages
  - Consumption Rate
  - In-Transit (Waiting for Ack)
  - Queue limit

- For every new Chunk Object

| Obj[0] | Obj[1] | Obj[2] | Obj[3] | . | . | . |

Message Queue
- Message Queue
- Pub/Sub Queue

- Validate Checksum
- Compute Time
- Failed Count
- CPU / Disk, etc

- **Processing Workers**
  - Compression Ratio
  - Storage Consumed
  - Object Count

- **Processed / Encoded Storage #Lossless #Lossy #Compression**

COMMON FAN-OUT SERVICES

| Obj[0] | Obj[1] | . | . | . |

Pub/Sub Queue

- **Log Processing Service**
- **Search Service #Index**
- **Notification Service**
- **Recommendation Service**
- **Analytics Service**
- **Payment charge Service**
  - With Idempotent Key
  - **Third-Party Banking Service**
  - Expired / Blocked / Invalid Card
  - Service Down
  - Insufficient Balance

- Spamming
- Stop Words
- Dedup
- Retry with Idempotent Key

Filtering:
- Content-Based
- Collaborative