



THE SYSTEM DESIGN

Topic Map



TRAFFIC AND EDGE

- **Load Balancing and Global Routing:** L4 and L7, DNS or anycast, health checks, failover
- **CDN and Edge Caching:** cache segmentation, signed URLs, origin shielding, privacy controls
- **API Gateway:** REST, GraphQL, gRPC, validation, OAuth2, OIDC, mTLS, per-route rate limits
- **Web Application Firewall (WAF) and request filtering**
- **Traffic Control:** quotas, backpressure, adaptive throttling



Umair Ahmad
in @umairahmadpm

NETWORKING AND COMMUNICATION

- **Protocols:** HTTP/HTTPS, WebSockets, SSE, gRPC, AMQP, MQTT
- **Service Discovery and Registry**
- **Service Mesh:** retries, timeouts, circuit breakers, traffic shifting
- **Inter-Process Communication:** synchronous vs asynchronous
- **Real-Time Communication:** long polling, pub/sub patterns



Umair Ahmad
in @umairahmadpm

DATA LAYER

- **Data Modeling:** normalization vs denormalization, schema evolution
- **Indexing and Query Optimization**
- **Transactions:** ACID and isolation levels
- **Database Types:** relational (SQL), key-value, document, column-family, graph, NewSQL
- **Distributed Database Concepts:** replication, sharding, partitioning, leader election
- **Consistency Models:** strong, eventual, causal



Umair Ahmad
in @umairahmadpm

CACHING & PERFORMANCE ENGINEERING

- **Cache Hierarchies:** client, edge, server, in-memory
- **Eviction Policies:** TTL, LFU, LRU, adaptive strategies
- **Coherency and Invalidation:** write-through, write-behind, background refresh
- **Performance Budgets:** latency and throughput targets
- **Tail Latency Reduction:** hedged requests, parallel queries
- **Capacity Planning:** queue depth analysis, resource modeling



Umair Ahmad
in @umairahmadpm

MESSAGING AND STREAMING

- **Message Brokers and Queues:** RabbitMQ, Kafka, SQS
- **Delivery Guarantees:** at-most-once, at-least-once, exactly-once (idempotency)
- **Ordering and Partition Keys**
- **Dead Letter Queues (DLQ) and poison message handling**
- **Event Sourcing and CQRS**
- **Change Data Capture (CDC) and schema registry**



Umair Ahmad
in @umairahmadpm

SEARCH AND ANALYTICS

- **Search Engines:** keyword, vector, hybrid
- **Ranking and Relevance Evaluation**
- **Reindexing and Schema Evolution**
- **Data Platform:** batch and streaming ETL/ELT
- **Warehousing and Lakehouse**
- **Metadata Management:** catalogs, lineage, data quality



Umair Ahmad
in @umairahmadpm

COMPUTE AND ORCHESTRATION

Umair Ahmad

- **Containerization:** Docker, container security
- **Orchestration:** Kubernetes primitives, operators, scheduling
- **Serverless Functions and event-driven compute**
- **Batch and Scheduled Jobs**
- **Autoscaling Strategies:** topology-aware placement, spot/on-demand mix



RESILIENCE AND RELIABILITY

- **Resilience Patterns:** retries with jitter, circuit breakers, bulkheads
- **Health Checks and Graceful Degradation**
- **Read-Only and Fallback Modes**
- **Chaos Engineering and fault injection**
- **Backups and Restores**
- **Disaster Recovery:** RPO and RTO per tier, cross-region failover



Umair Ahmad
in @umairahmadpm

SECURITY AND IDENTITY

- **IAM Models:** RBAC, ABAC, workload identity
- **AuthN and AuthZ:** OAuth2, OIDC, JWT, PASETO
- **Secrets Management:** vaults, rotation, KMS/HSM
- **Encryption:** in transit and at rest
- **Threat Mitigation:** XSS, CSRF, SQL injection, SSRF, MITM
- **Secure Defaults and Hardened Baselines**



Umair Ahmad
in @umairahmadpm

OBSERVABILITY AND OPERATIONS

- **Metrics, Logs, Traces, Profiles**
- **Synthetic Monitoring and RUM**
- **SLO Burn Rate Alerts**
- **Dashboards and Guardrails**
- **Runbooks and Playbooks**
- **Incident Management and Postmortems**



Umair Ahmad
in @umairahmadpm

DELIVERY AND PLATFORM ENGINEERING

- **CI/CD Pipelines and artifact management**
- **Infrastructure as Code:** Terraform, CloudFormation, Ansible
- **Environment Promotion:** dev, staging, prod
- **Deployment Strategies:** canary, blue-green, rolling
- **Feature Flags and Kill Switches**
- **Configuration Management**



Umair Ahmad
in @umairahmadpm

PRODUCT, COST, AND COMPLIANCE

- **Non-Functional Requirements (NFRs):** scalability, reliability, maintainability
- **Trade-Off Frameworks:** CAP, PACELC
- **Experimentation:** A/B testing, guardrails, rollout governance
- **FinOps:** cost attribution, budget alerts, optimization
- **Privacy and Data Governance:** classification, retention, deletion policies
- **Audit Logging and Compliance:** GDPR, HIPAA, SOC2



Umair Ahmad

Senior Data & Technology Leader

 @umairahmadpm

Did you like the post?



Follow us for more tips and tricks!