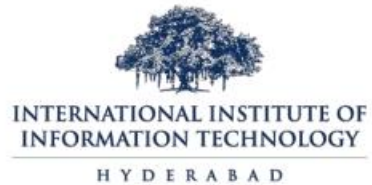
Software System Design

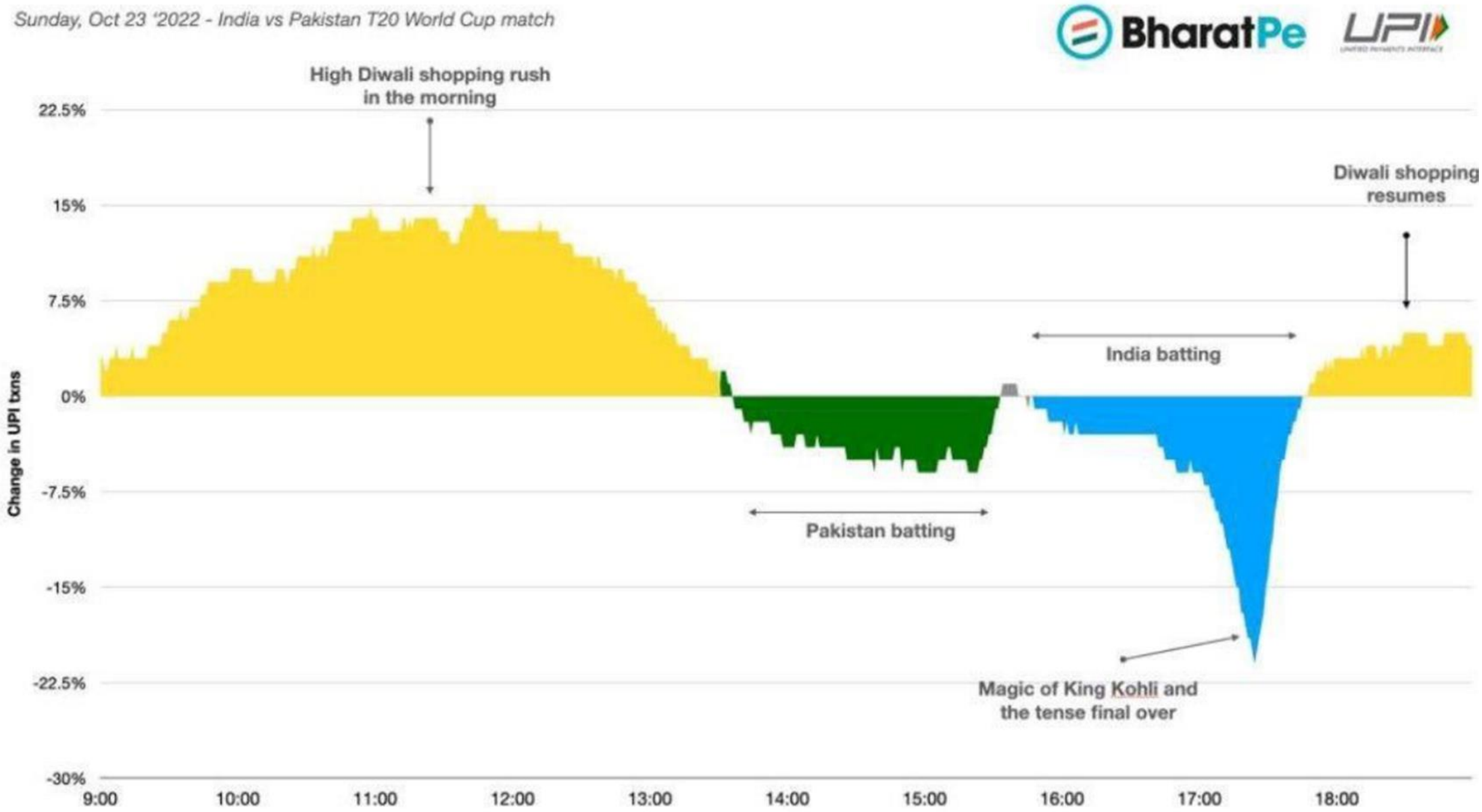
PG – Monsoon 2025

Software Engineering Research Center

IIIT Hyderabad, India



Sunday, Oct 23 '2022 - India vs Pakistan T20 World Cup match




lime juice
Kasuri Methi
Green Chillies
Mint leaves
Garlic
Ginger
Onion
Salt
Cooking Oil
red chilli powder
Ghee
Whole spices
Turmeric Powder
Hung Curds
Corinader leaves
Jeera Rice (short grain rice)
Chicken


Oil
Bay Leaf
Onion
Tomatoes
Star Anise
Ghee
Mint
Turmeric
Grinding Ingredients
Seeraga Samba Rice
Salt
Coriander Leaves
Mixed Veggies
Curd

High Level Vs Low Level Design

- HLD - Architecture Diagrams, Component Diagrams, APIs etc.
- LLD – Class Diagrams, Database Diagrams, DFD

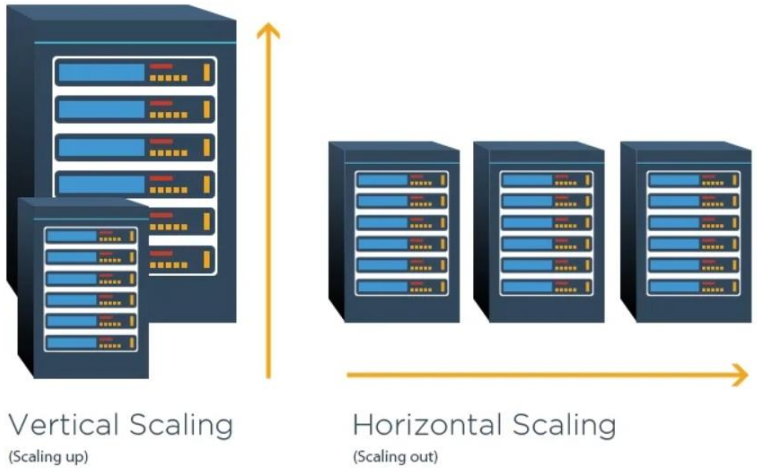
Key Goals

Scalability, Reliability, Availability, Performance, Cost Effective

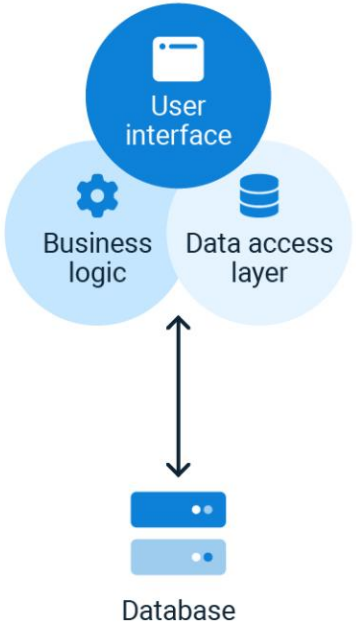
Building Blocks of a Software System

Servers: Hosting, Load Balancing, CDN, DNS
Access Protocols: HTTPS-SSL/TLS, Proxy, Reverse-Proxy
Data: Relational, Warehouse, Data Cube, Data Lake, Unstructured
Messages: SMTP, POP3, Push Notifications, Message Queues
API Gateways: SOAP, REST API, ODATA, Micro-Services, WebHook
File Transfer: FTP, SFTP-SSH
Authentication: SSO/SAML/LDAP
Authorization: OAuth with Grant Type: CC/AC/RP/DC/RT/PKCE
Deployment Style: IaaS, PaaS, SaaS, Hosted, On-Premise
Release Management: In-place, Installer, Orchestration
Reporting & Logging: In-App, Out-App, Plugins
Framework: CMS, CRM, Full-Pack Ecosystems, In-house Custom

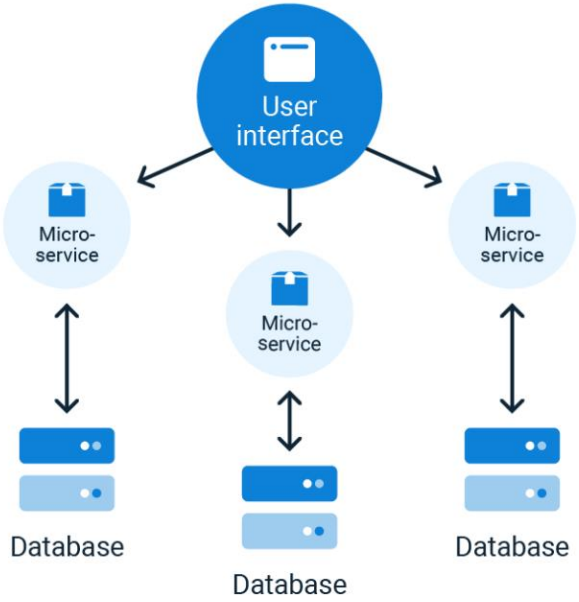
Scalability

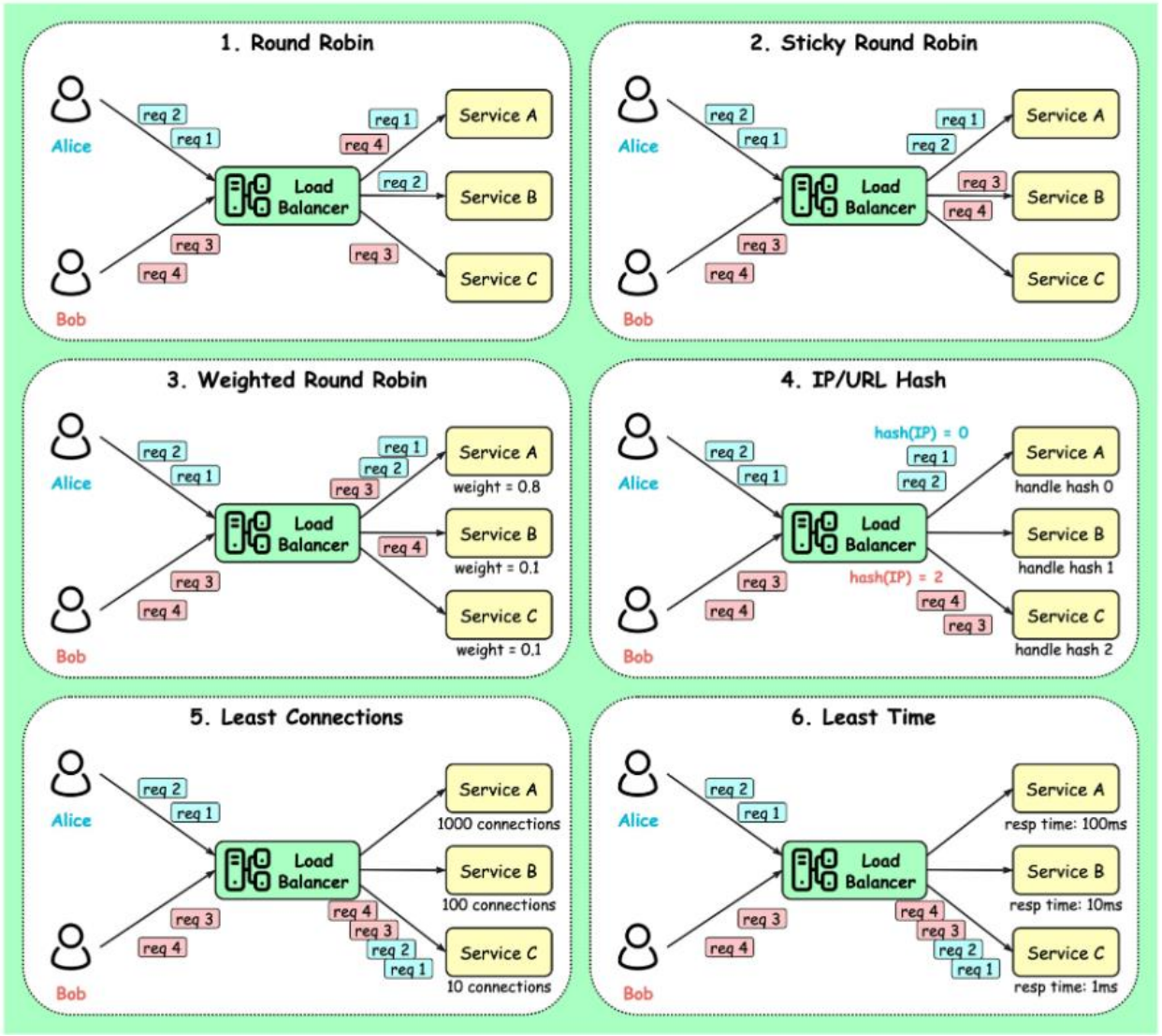


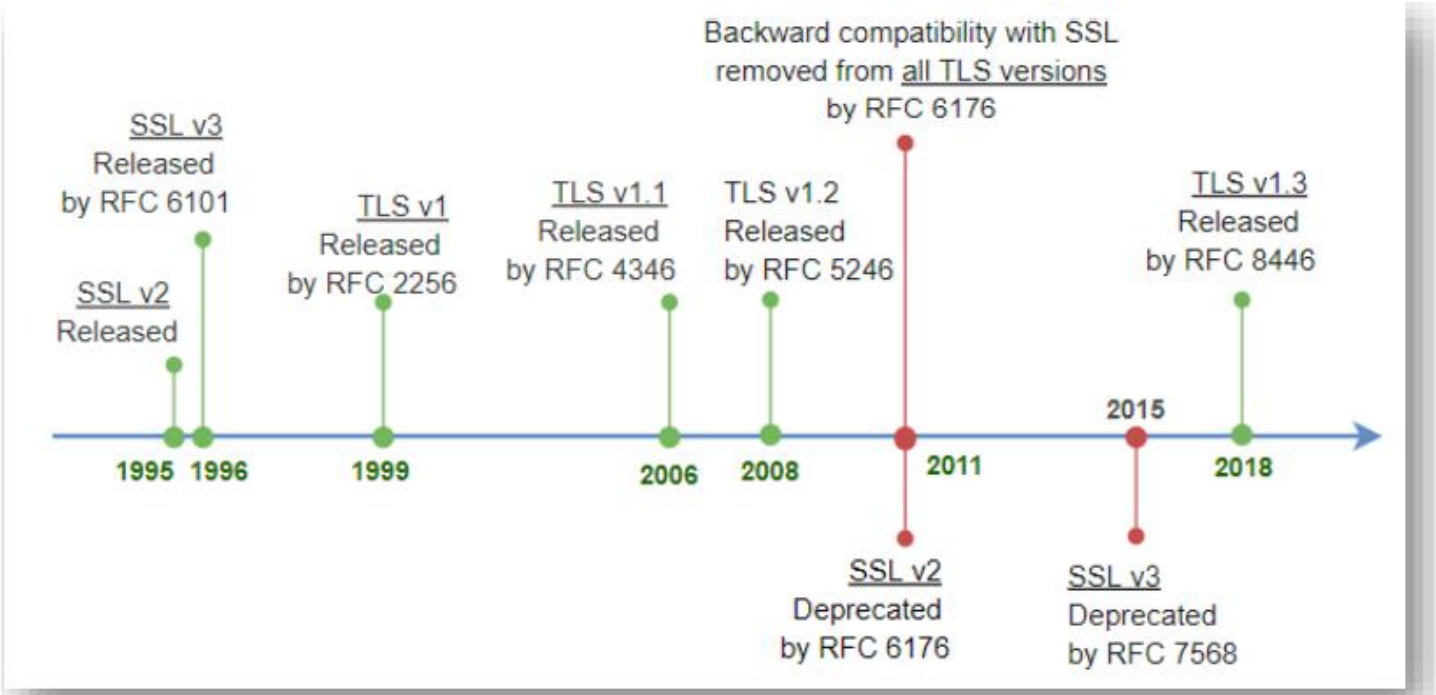
Monolithic Architecture

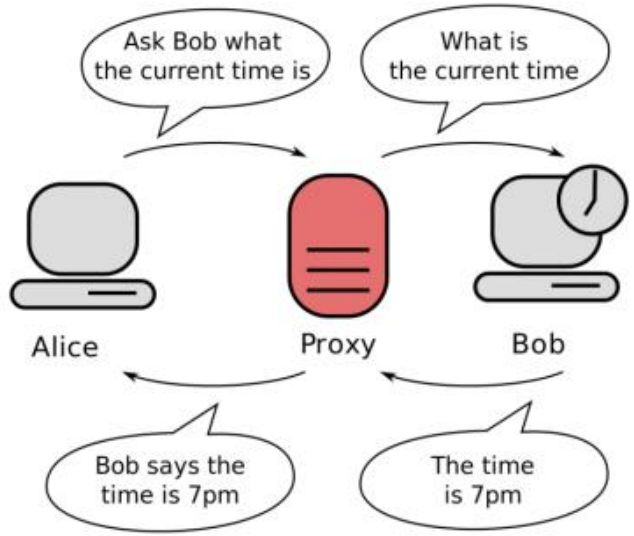


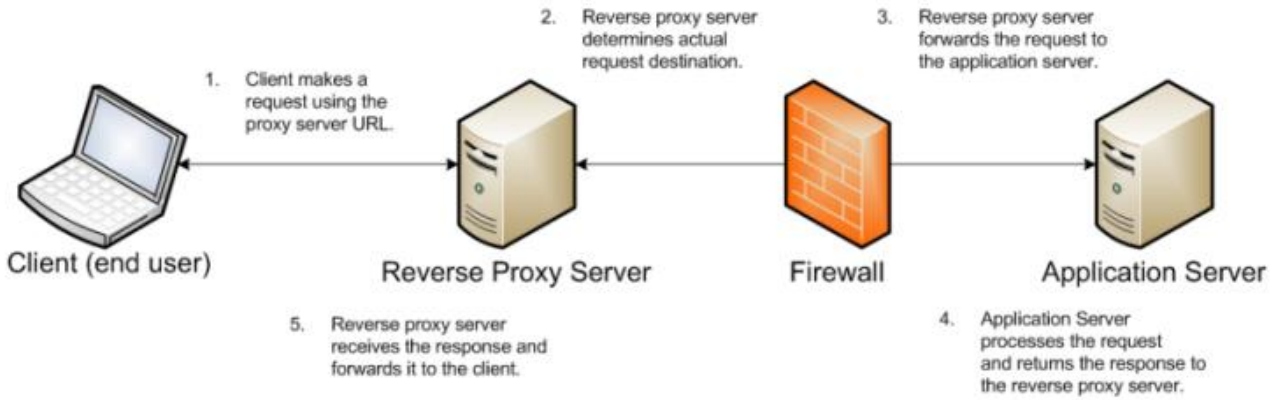
Microservice Architecture

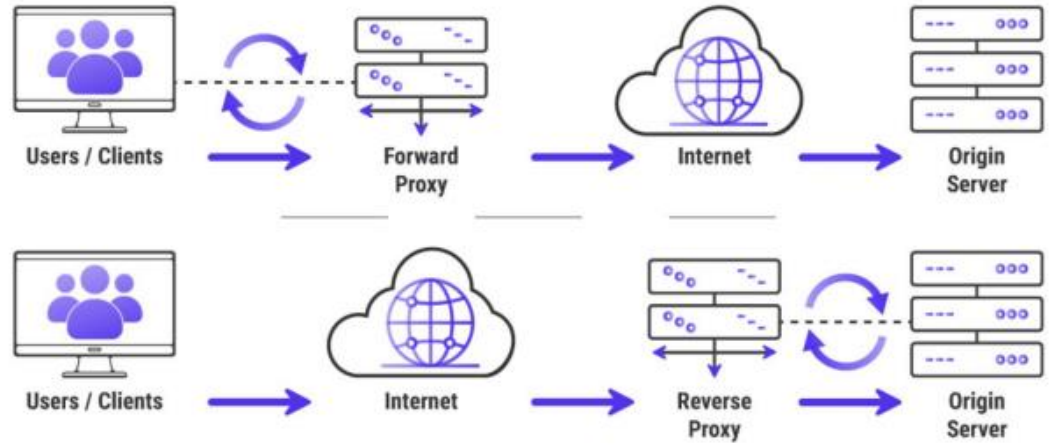


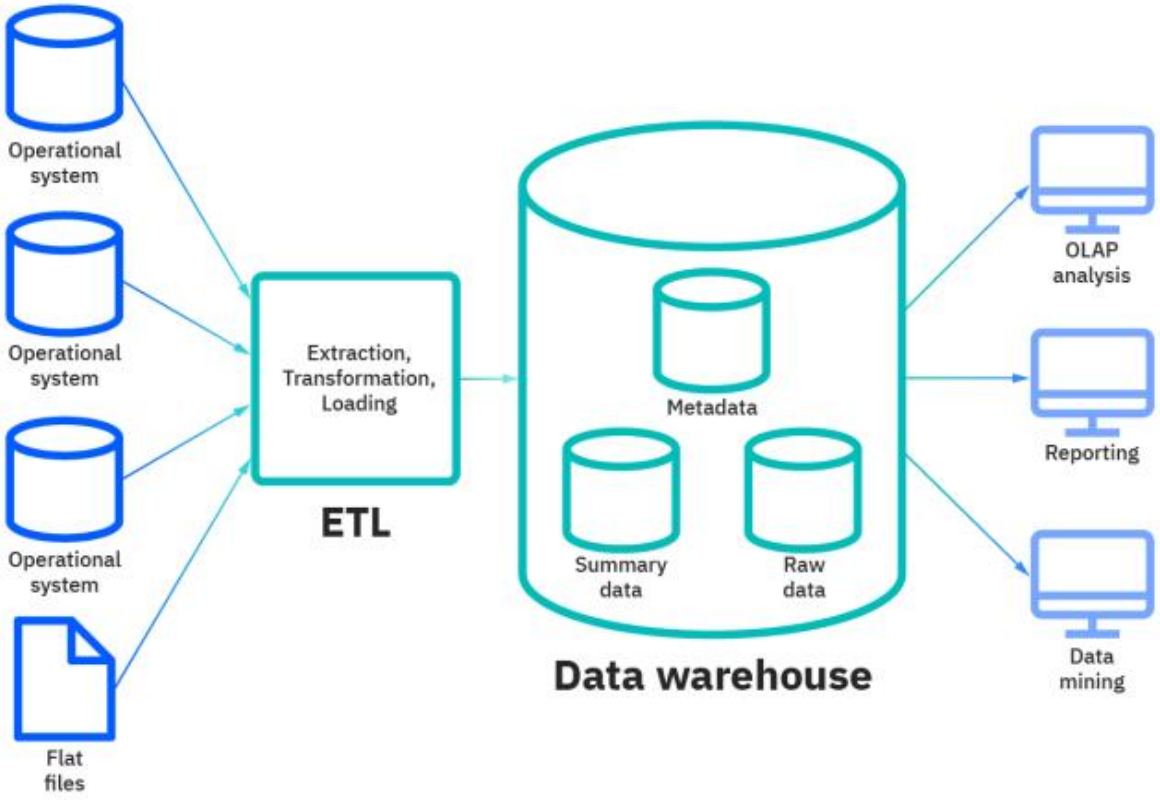


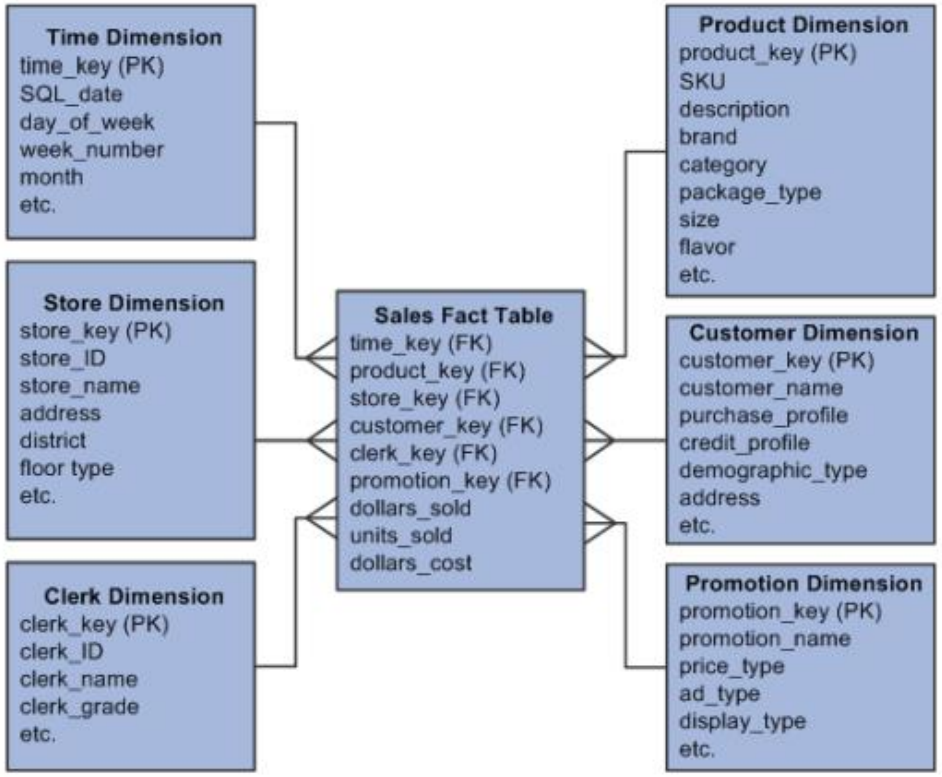

Backward compatibility with SSL removed from all TLS versions by RFC 6176
SSL v3 Released by RFC 6101
SSL v2 Released
TLS v1 Released by RFC 2256
TLS v1.1 Released by RFC 4346
TLS v1.2 Released by RFC 5246
TLS v1.3 Released by RFC 8446
1995
1996
1999
2006
2008
2011
2015
2018
SSL v2 Deprecated by RFC 6176
SSL v3 Deprecated by RFC 7568

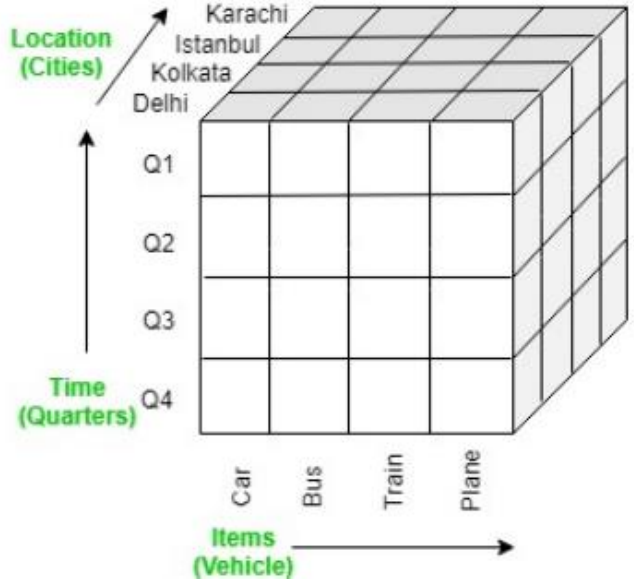

Ask Bob what the current time is
What is the current time
Alice
Proxy
Bob
Bob says the time is 7pm
The time is 7pm


1. Client makes a request using the proxy server URL.
2. Reverse proxy server determines actual request destination.
3. Reverse proxy server forwards the request to the application server.
Client (end user)
Reverse Proxy Server
Firewall
Application Server
4. Application Server processes the request and returns the response to the reverse proxy server.
5. Reverse proxy server receives the response and forwards it to the client.


Users / Clients
Forward Proxy
Internet
Origin Server
Users / Clients
Internet
Reverse Proxy
Origin Server



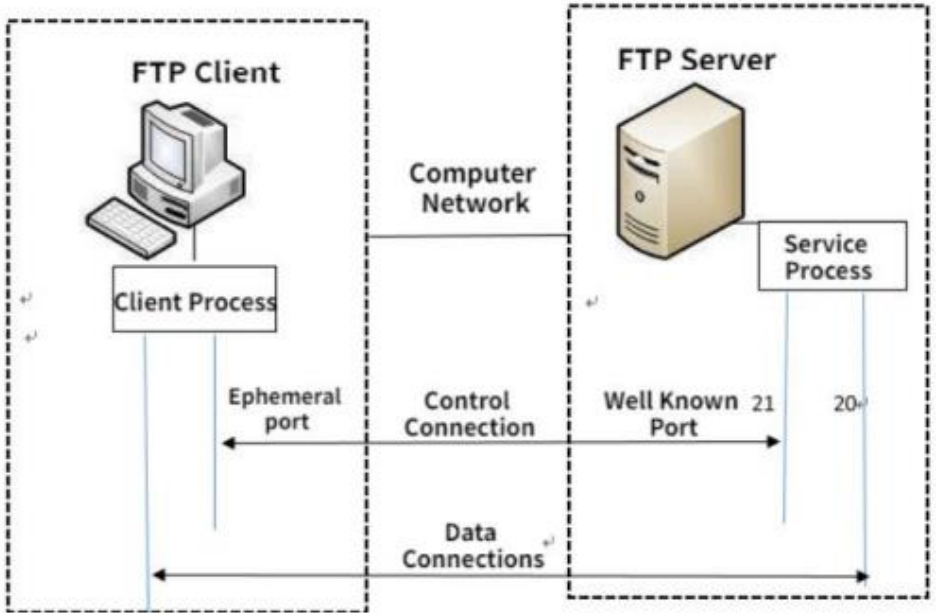


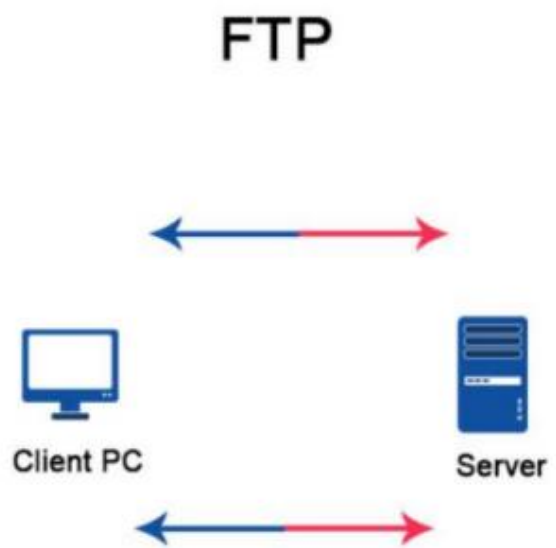


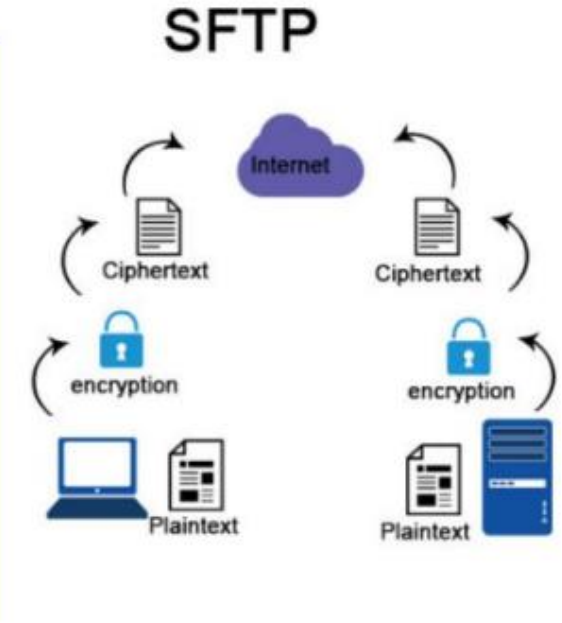
Replication – Publisher [Distributor] Subscriber

Change Data Capture * Change Tracking

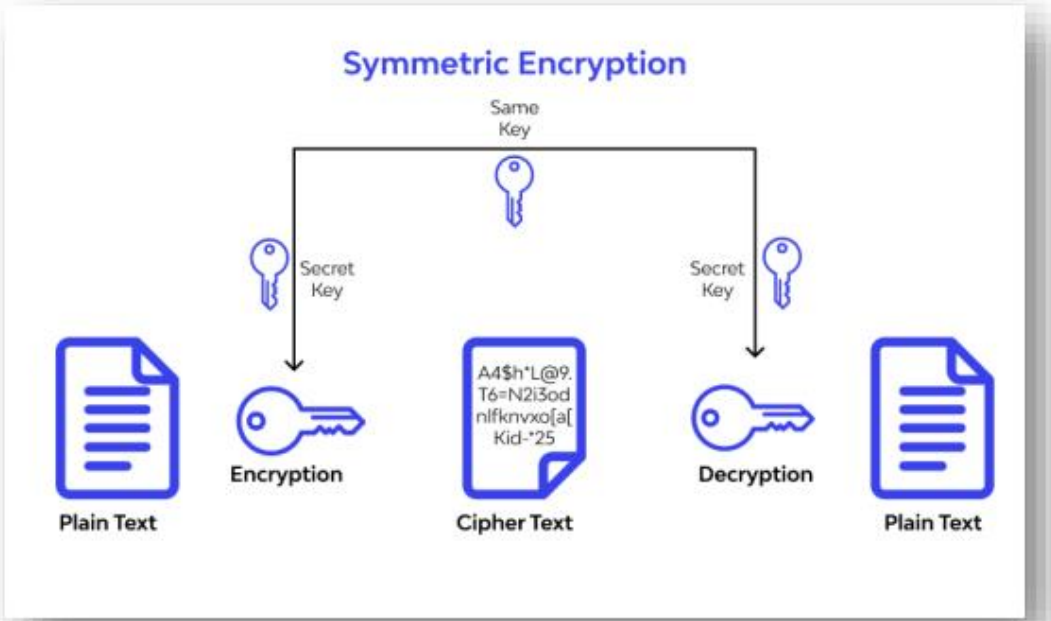
Some Types: Transactional – Snapshot – Peer2Peer

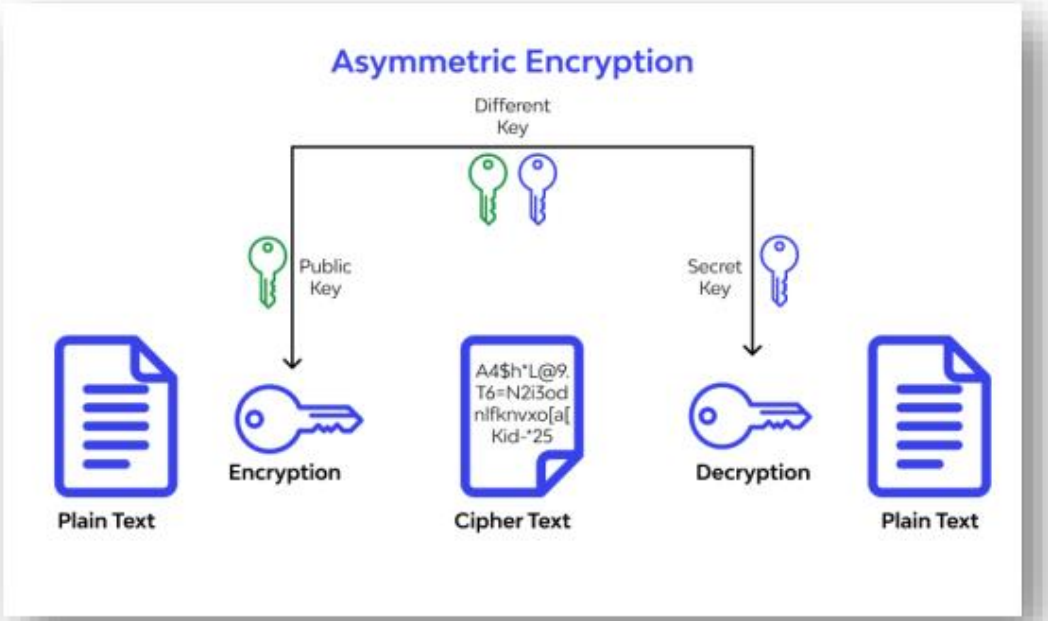


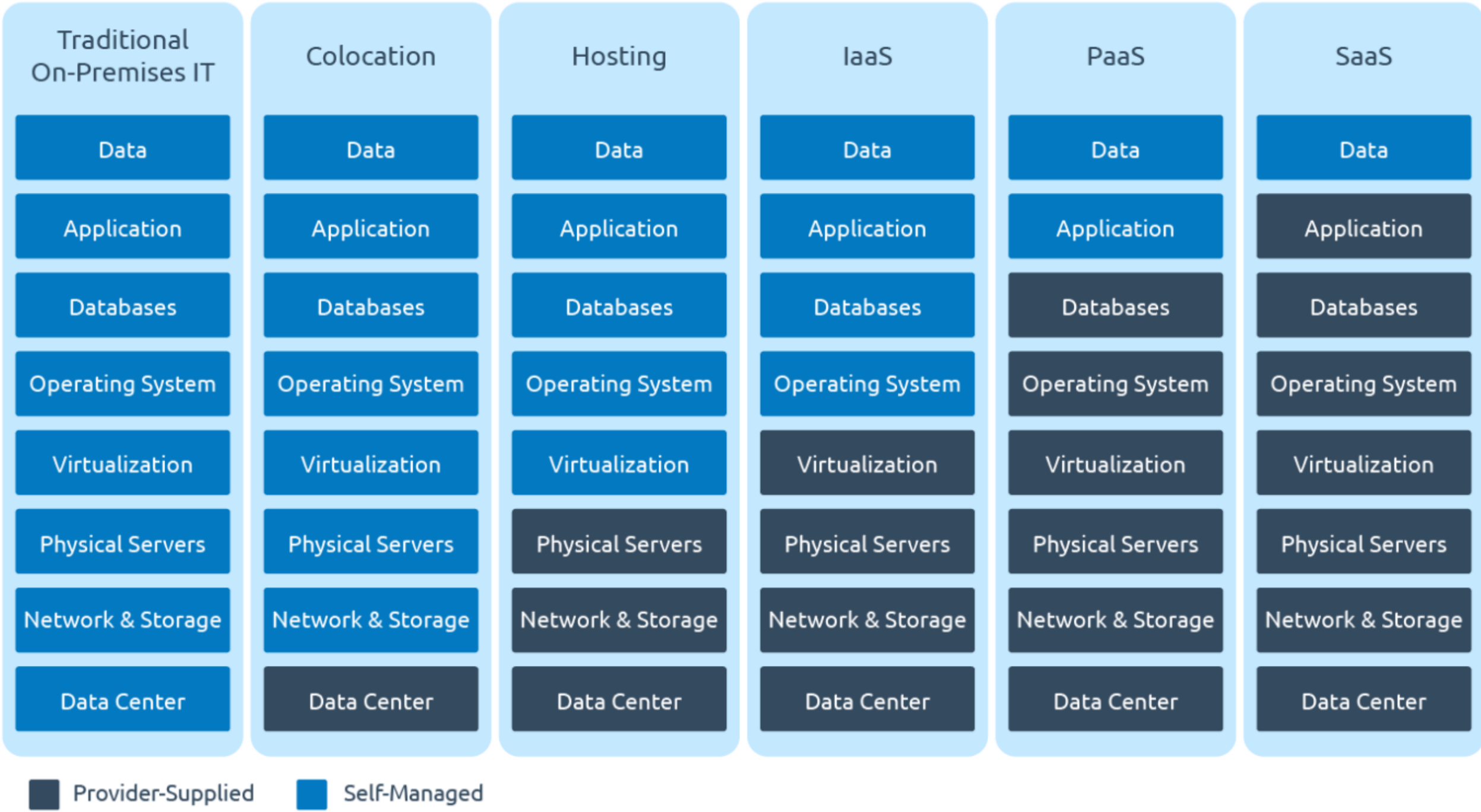


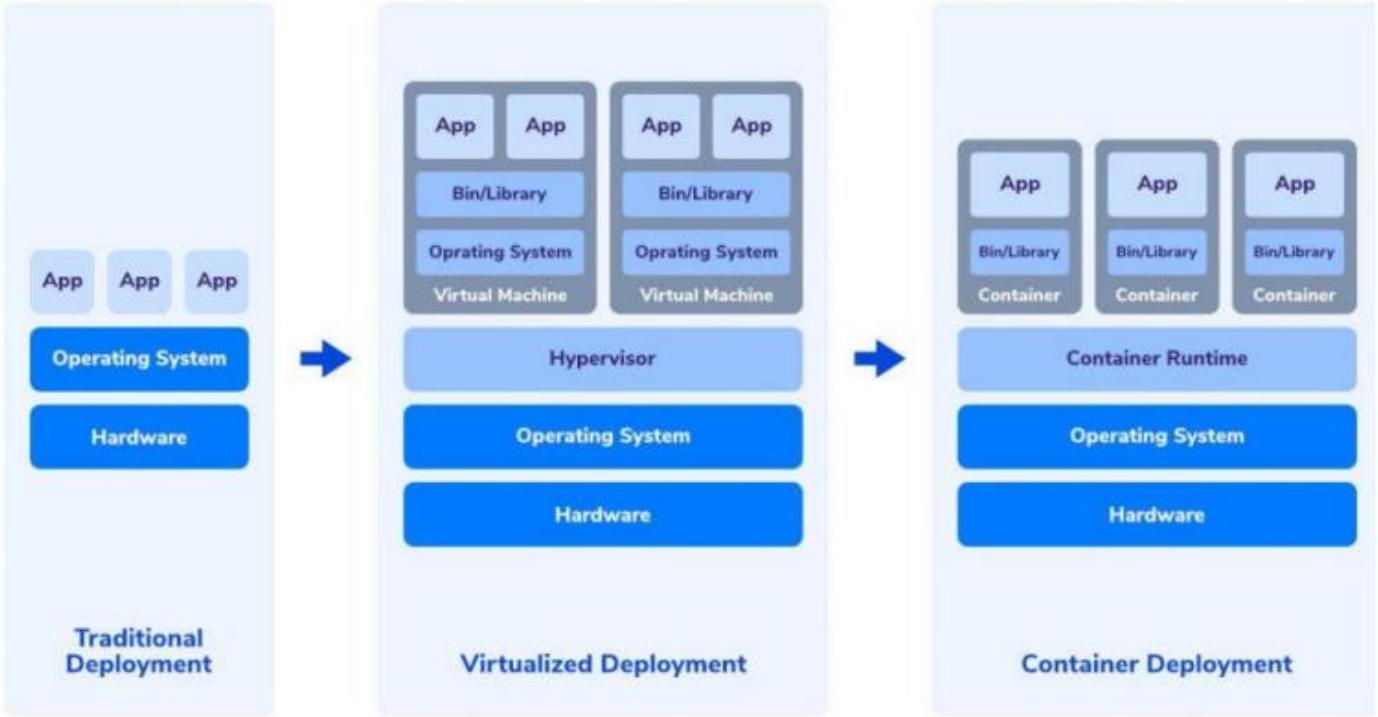


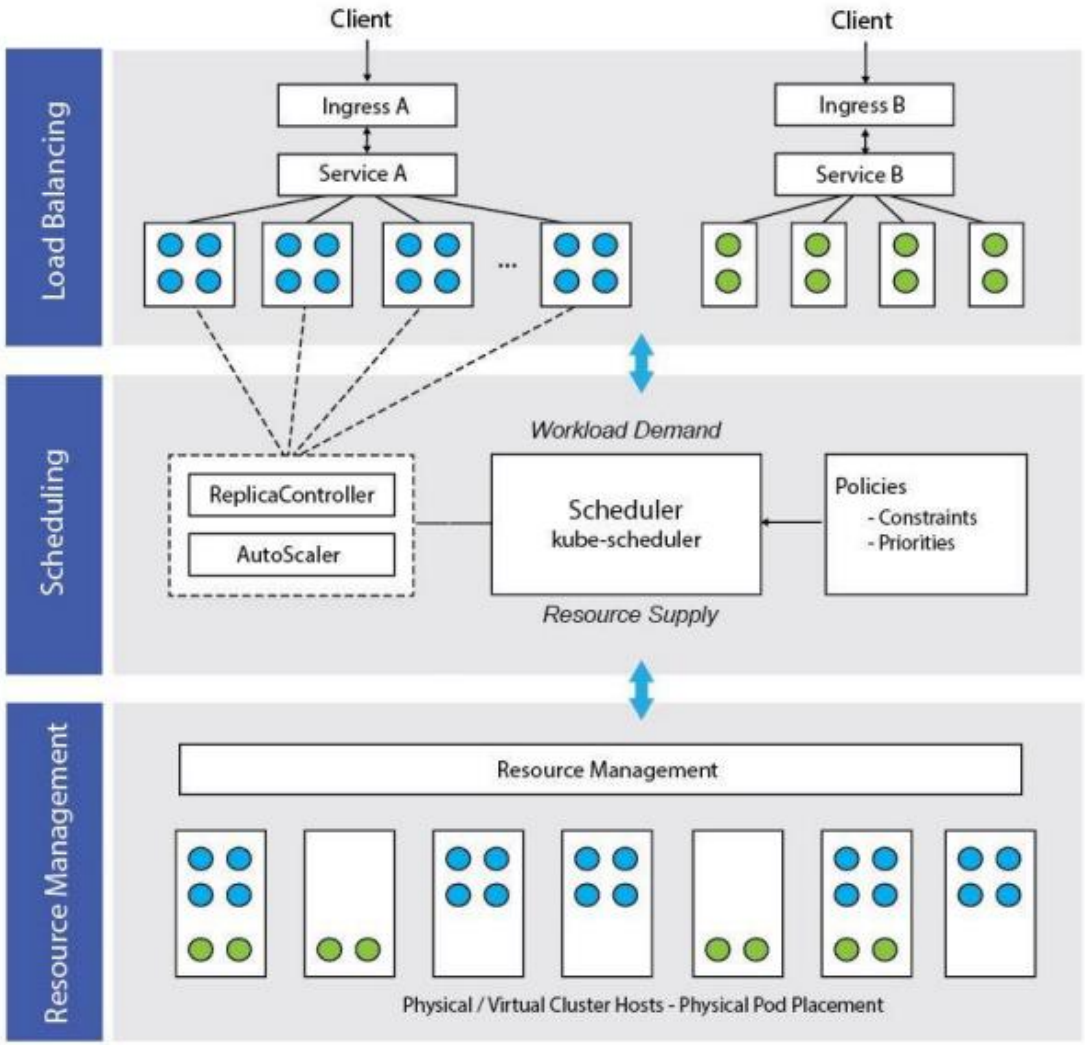
SSH – Secure Shell Protocol

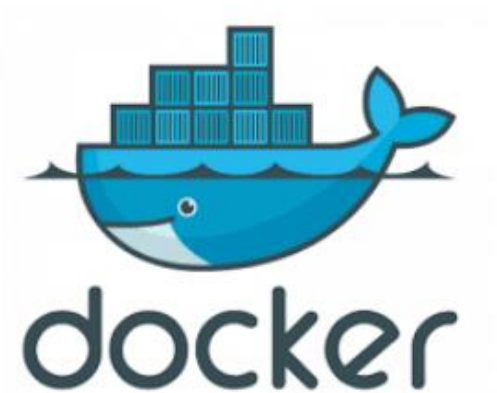





Traditional On-Premises IT
Colocation
Hosting
IaaS
PaaS
SaaS
Data
Application
Databases
Operating System
Virtualization
Physical Servers
Network & Storage
Data Center
Provider-Supplied
Self-Managed

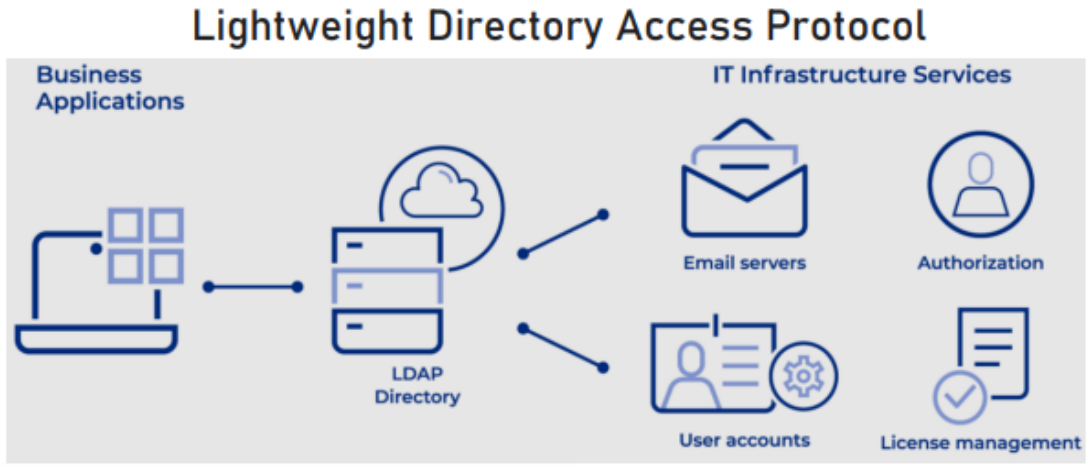


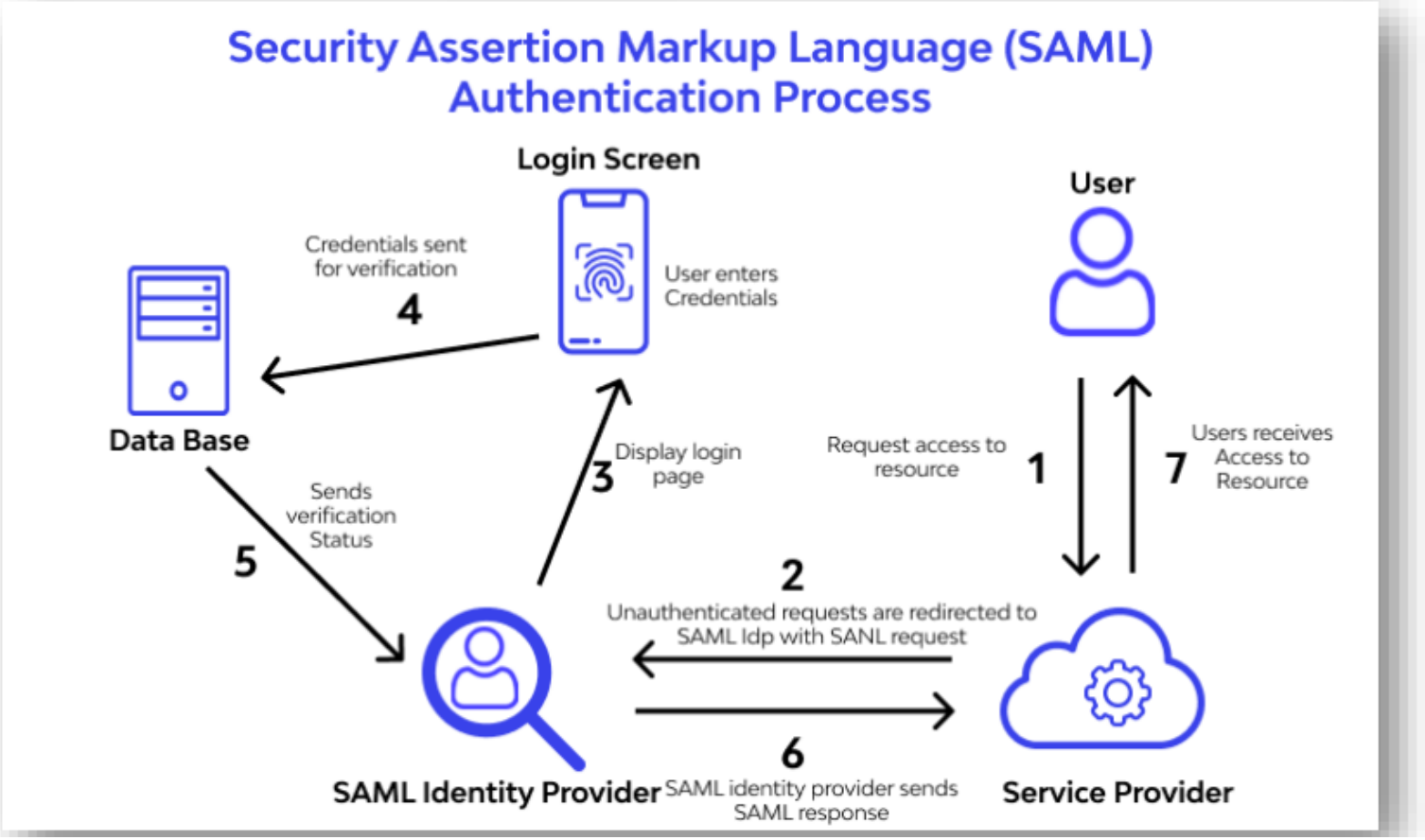


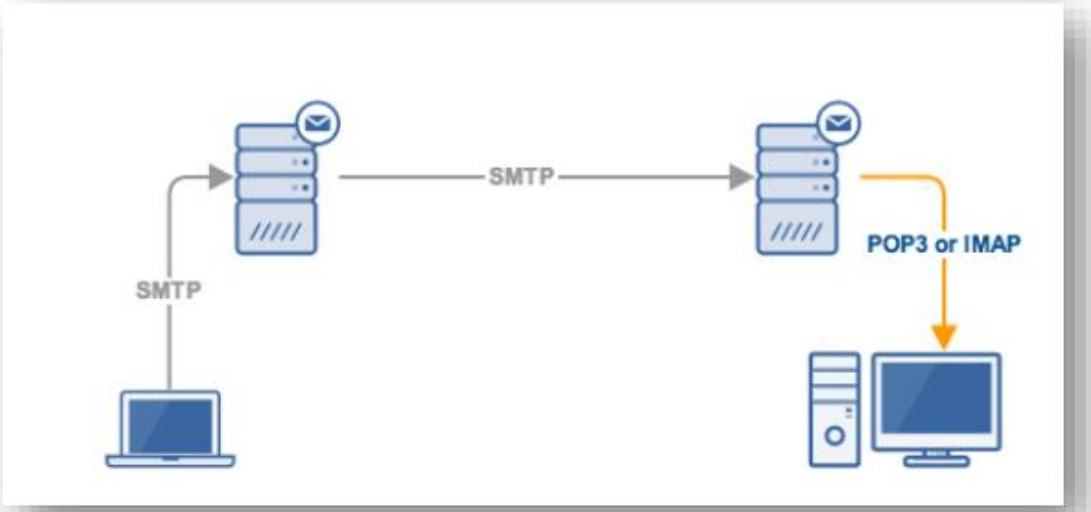


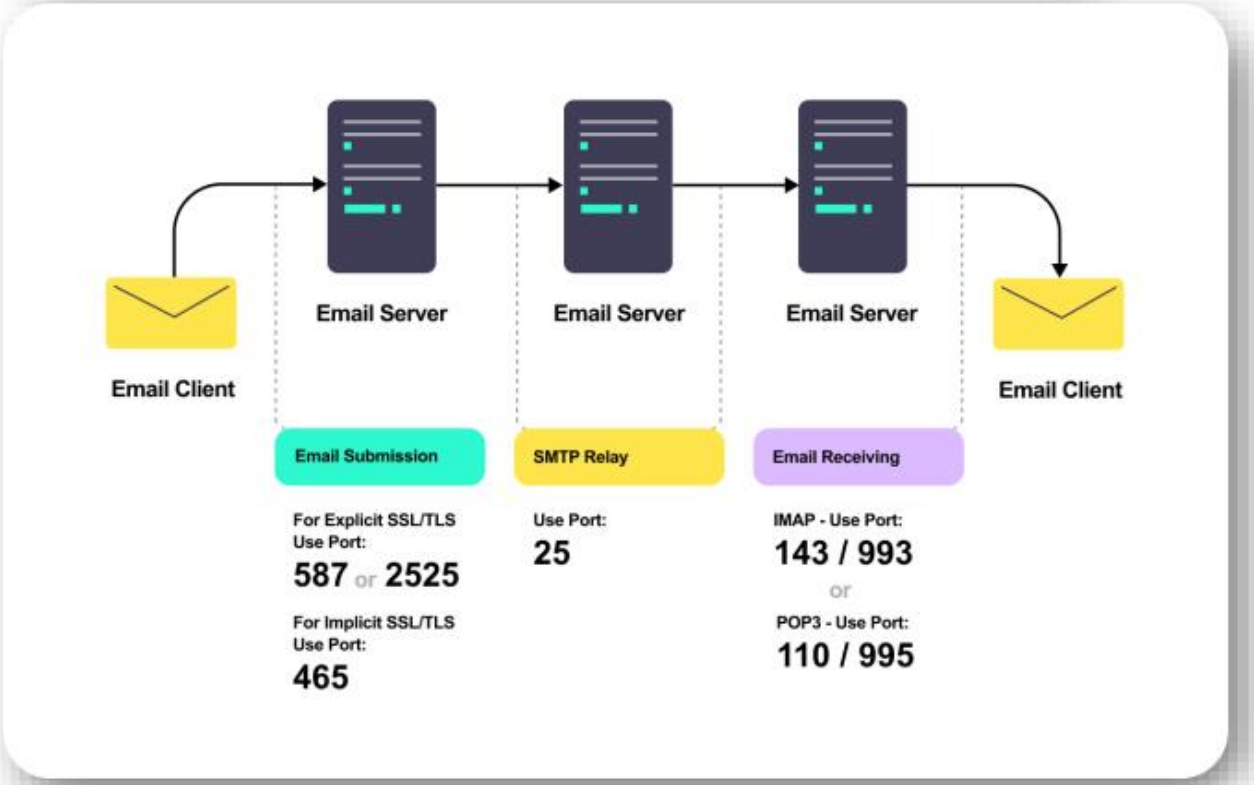
Tenant << Node<< Cluster

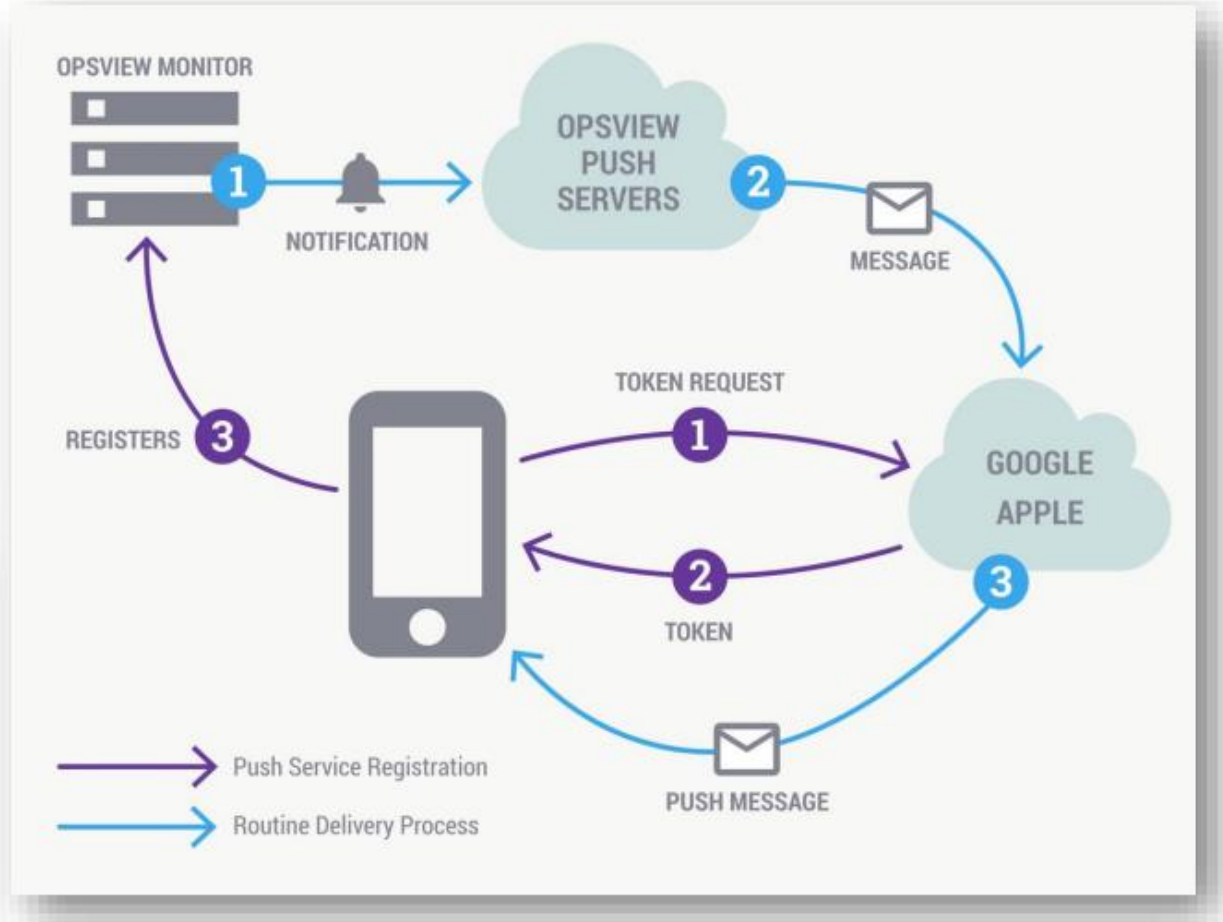

End-User
Single Sign-On
Multiple Applications and Systems


Lightweight Directory Access Protocol
Business Applications
IT Infrastructure Services
Email servers
Authorization
LDAP Directory
User accounts
License management

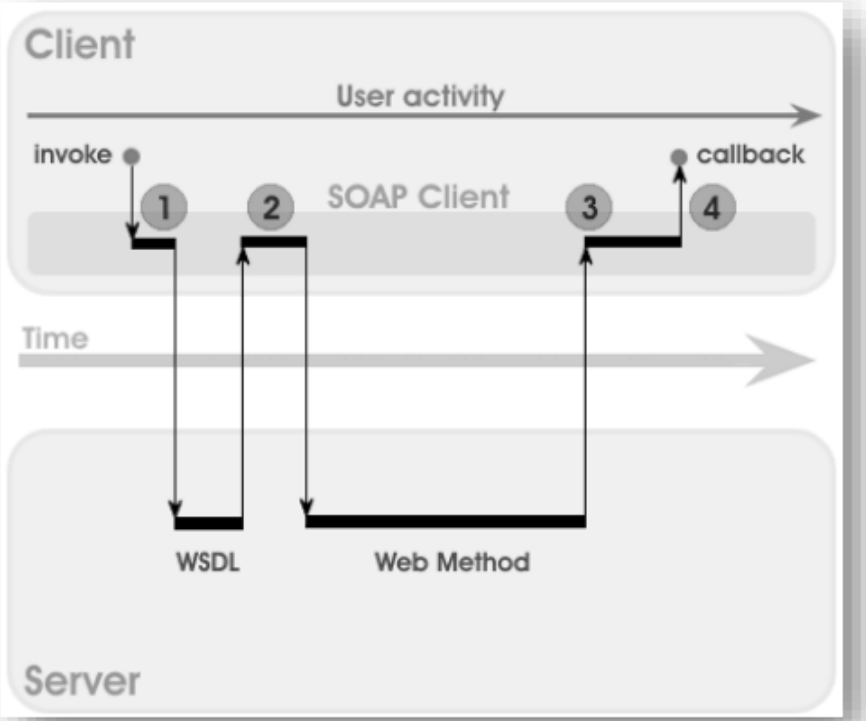

Security Assertion Markup Language (SAML) Authentication Process
Login Screen
User
Credentials sent for verification
4
User enters Credentials
Data Base
Request access to resource
1
7
Users receives Access to Resource
Display login page
3
Sends verification Status
5
2
Unauthenticated requests are redirected to SAML Idp with SANL request
6
SAML identity provider sends SAML response
SAML Identity Provider
Service Provider

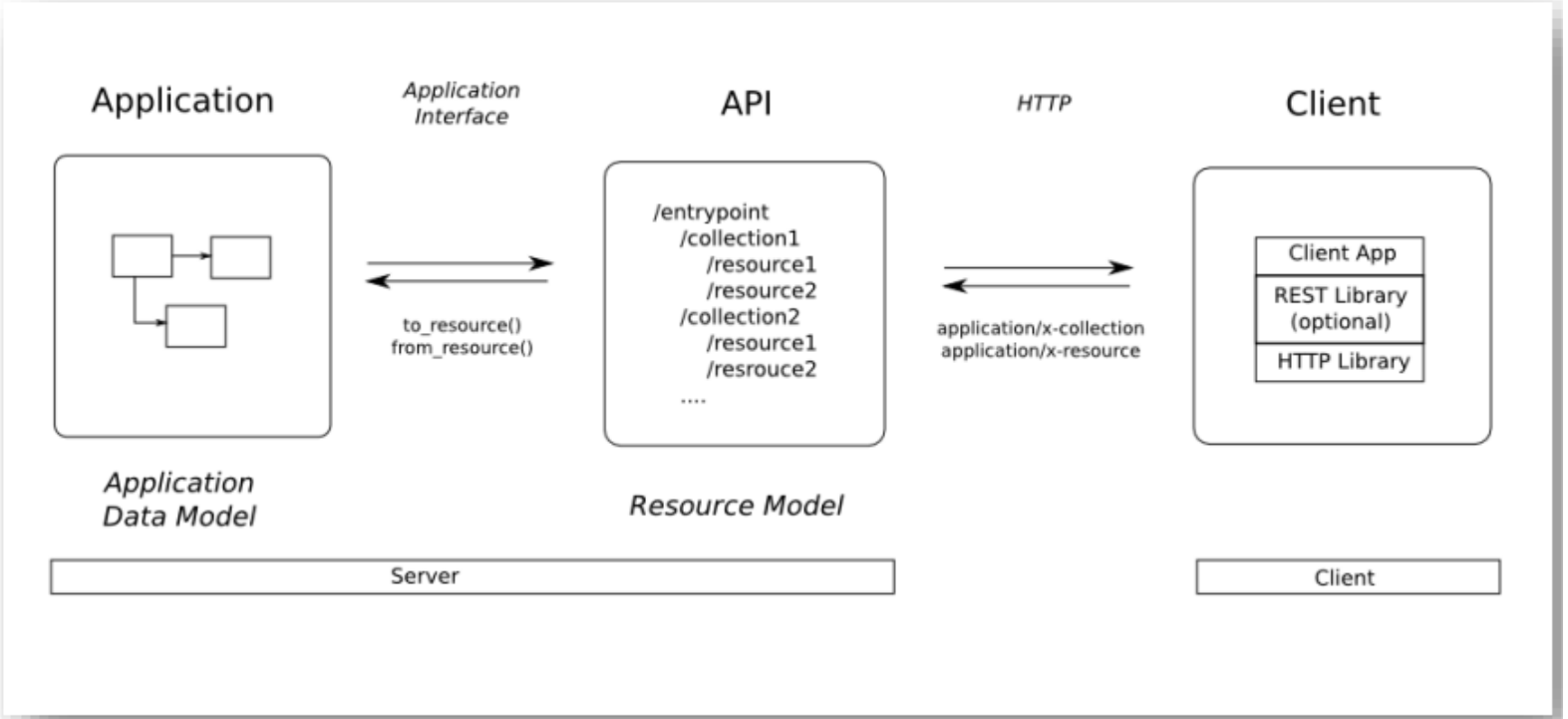


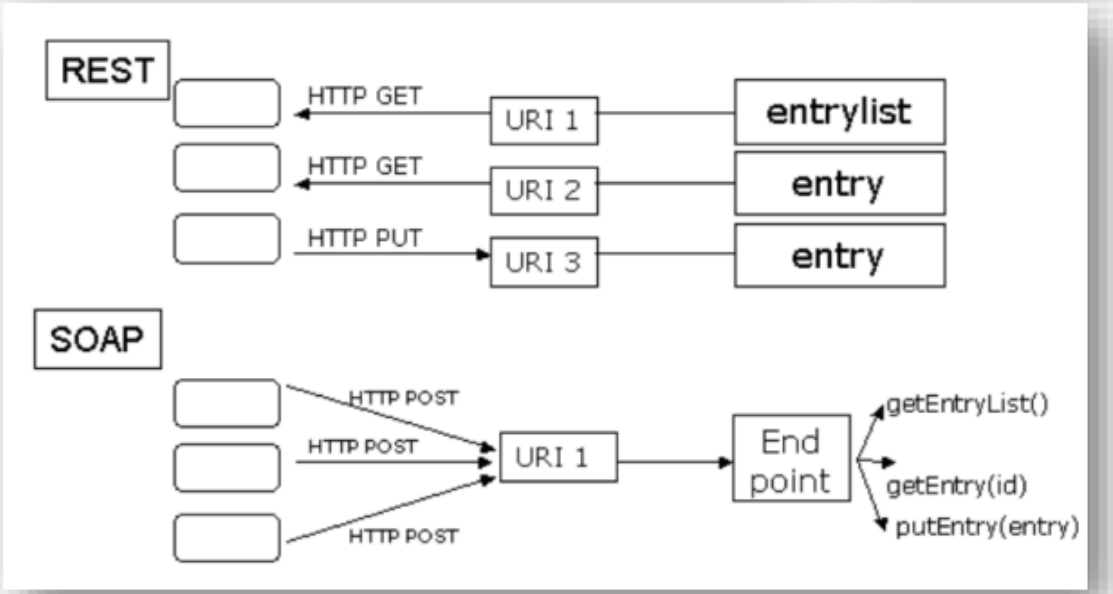


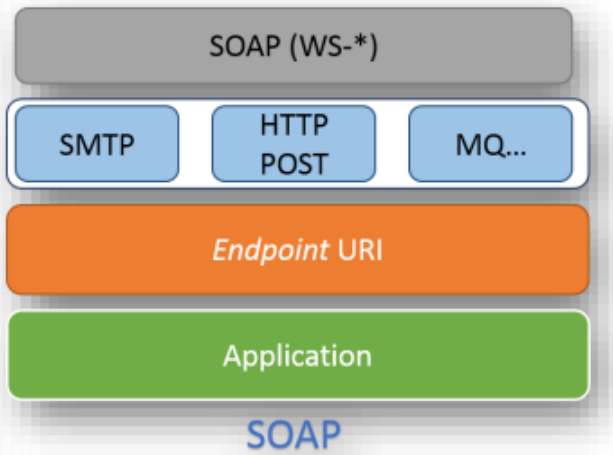


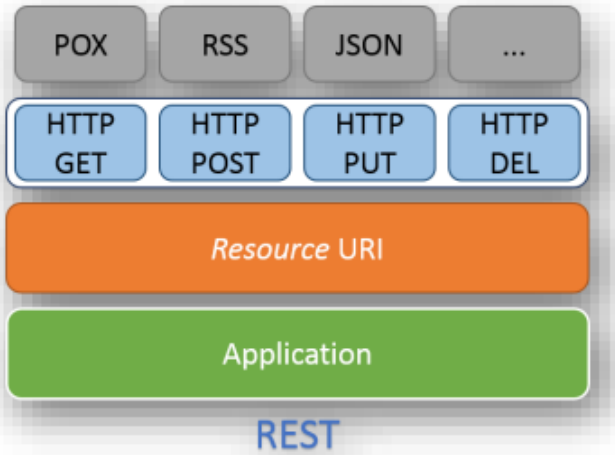
Simple Mail Transfer
Post Office Protocol (POP3)
Internet Messaging Access Protocol


Client
User activity
invoke
callback
1
2
SOAP Client
3
4
Time
WSDL
Web Method
Server


Application
Application Interface
API
HTTP
Client
/entrypoint
/collection1
/resource1
/resource2
/collection2
/resource1
/resrouce2
....
to_resource()
from_resource()
application/x-collection
application/x-resource
Client App
REST Library (optional)
HTTP Library
Application Data Model
Resource Model
Server
Client


REST
HTTP GET
URI 1
entrylist
HTTP GET
URI 2
entry
HTTP PUT
URI 3
entry
SOAP
HTTP POST
HTTP POST
HTTP POST
URI 1
End point
getEntryList()
getEntry(id)
putEntry(entry)


SOAP (WS-*)
SMTP
HTTP POST
MQ...
Endpoint URI
Application
SOAP


POX
RSS
JSON
...
HTTP GET
HTTP POST
HTTP PUT
HTTP DEL
Resource URI
Application
REST

HTTP BASIC AUTHENTICATION

The simplest way to handle authentication is through the use of HTTP, where the username and password are sent alongside every API call.

API KEY AUTHENTICATION

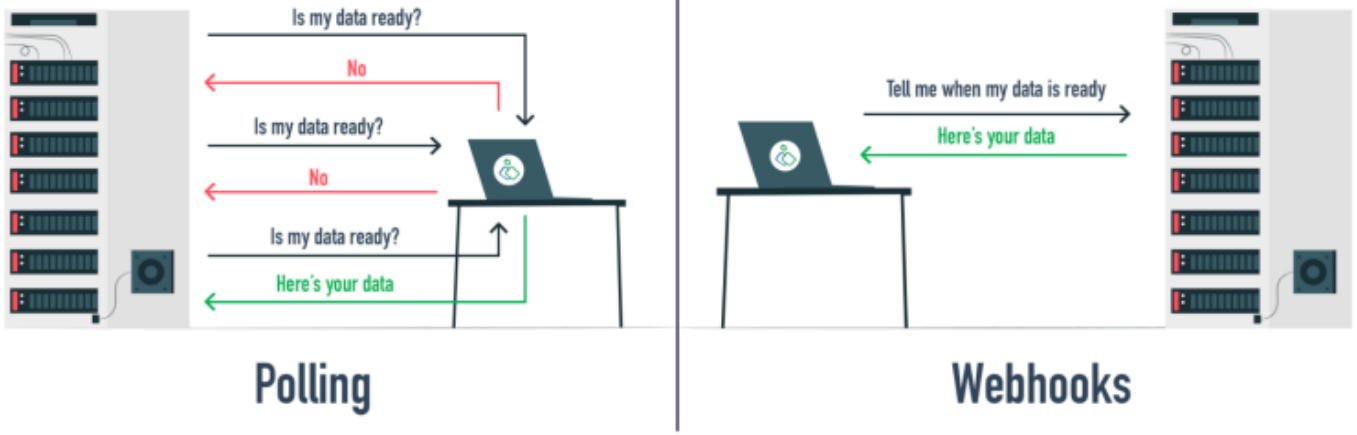
This method creates unique keys for developers and passes them alongside every request. The API generates a secret key that is a long, difficult-to-guess string of numbers.

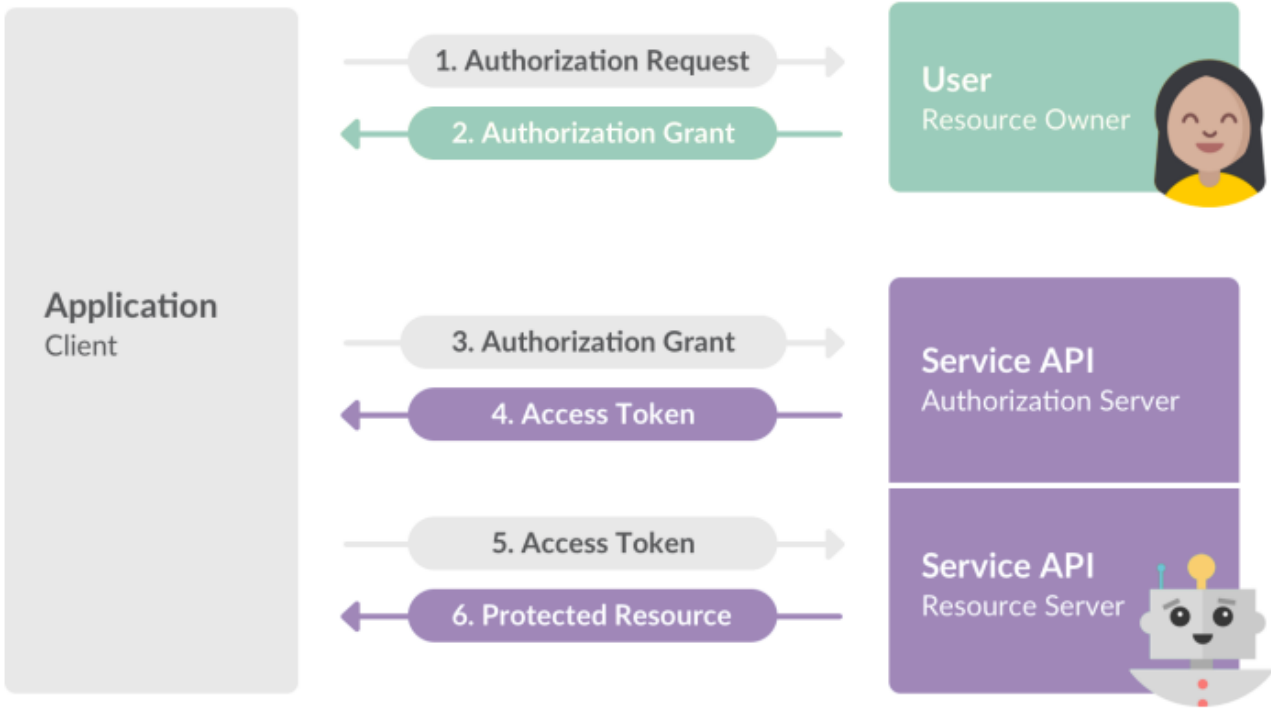
OAUTH AUTHENTICATION

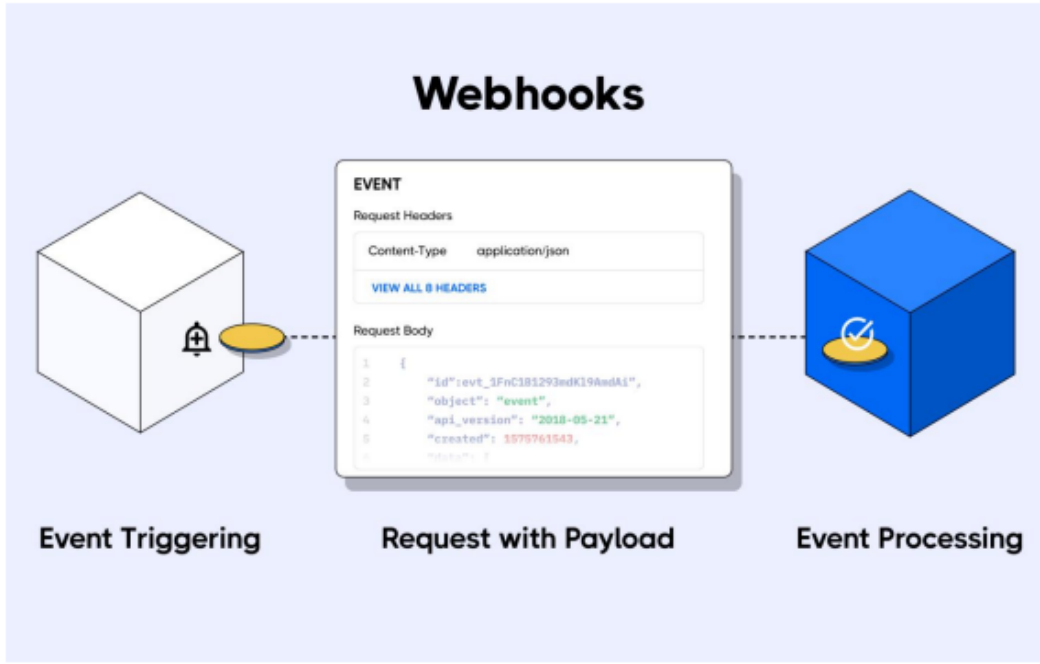
This framework can orchestrate approvals automatically between the API owner and the service, or you can also authorize developers to obtain access on their own.

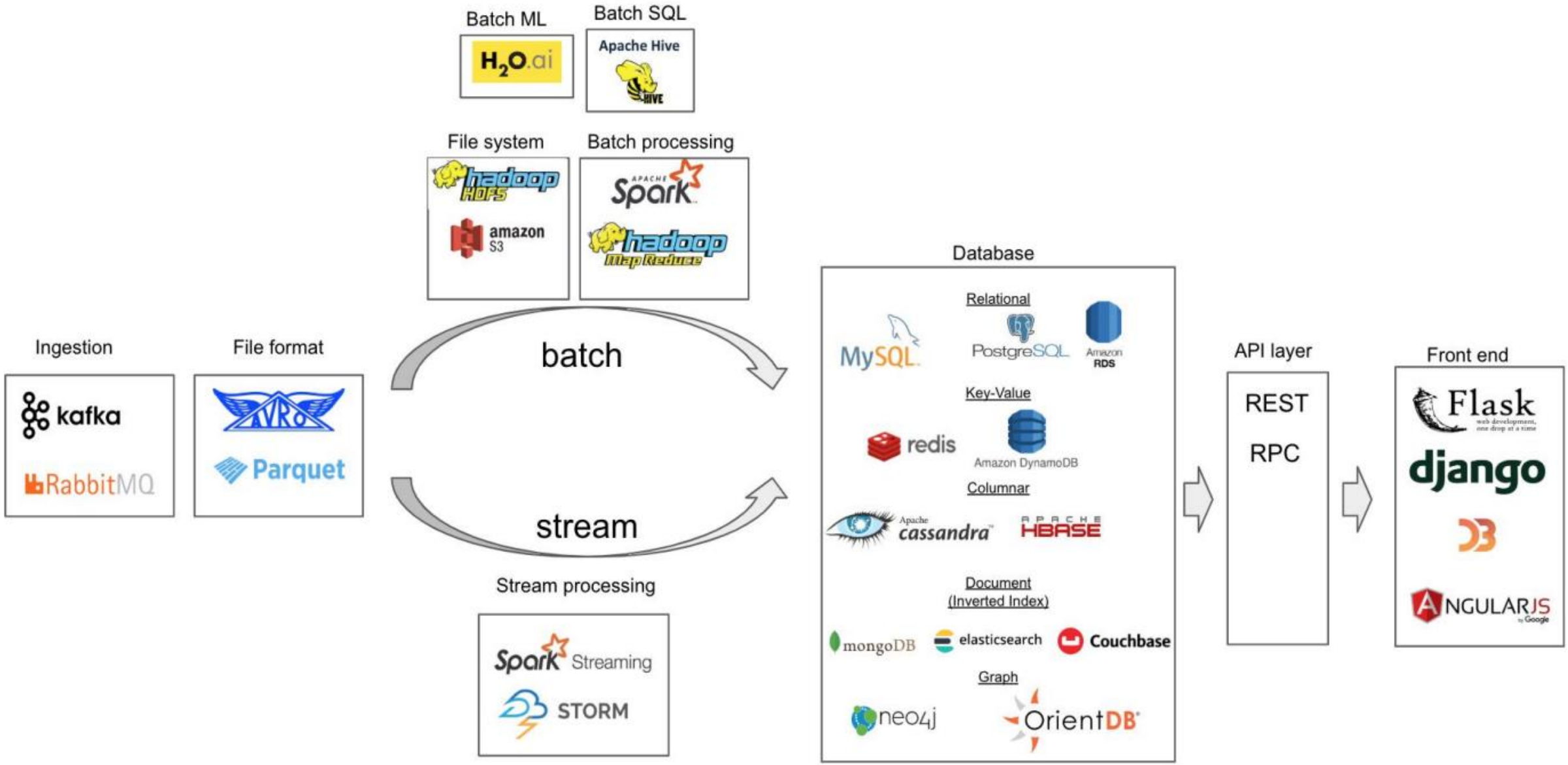
OR... NO AUTHENTICATION

There's always the option of applying no authentication at all. This approach is commonly used in internal APIs hosted on-premise but is not a recommended practice.








Batch ML
Batch SQL
Apache Hive
File system
Batch processing
batch
Ingestion
File format
kafka
RabbitMQ
Parquet
stream
Stream processing
Spark Streaming
STORM
Database
Relational
MySQL
PostgreSQL
Amazon RDS
Key-Value
redis
Amazon DynamoDB
Columnar
Apache cassandra
HBASE
Document (Inverted Index)
mongoDB
elasticsearch
Couchbase
Graph
neo4j
OrientDB
API layer
REST
RPC
Front end
Flask
django
ANGULARJS

Content Management System

Drupal™
Joomla!®
PrestaShop
Magento An Adobe Company
SharePoint

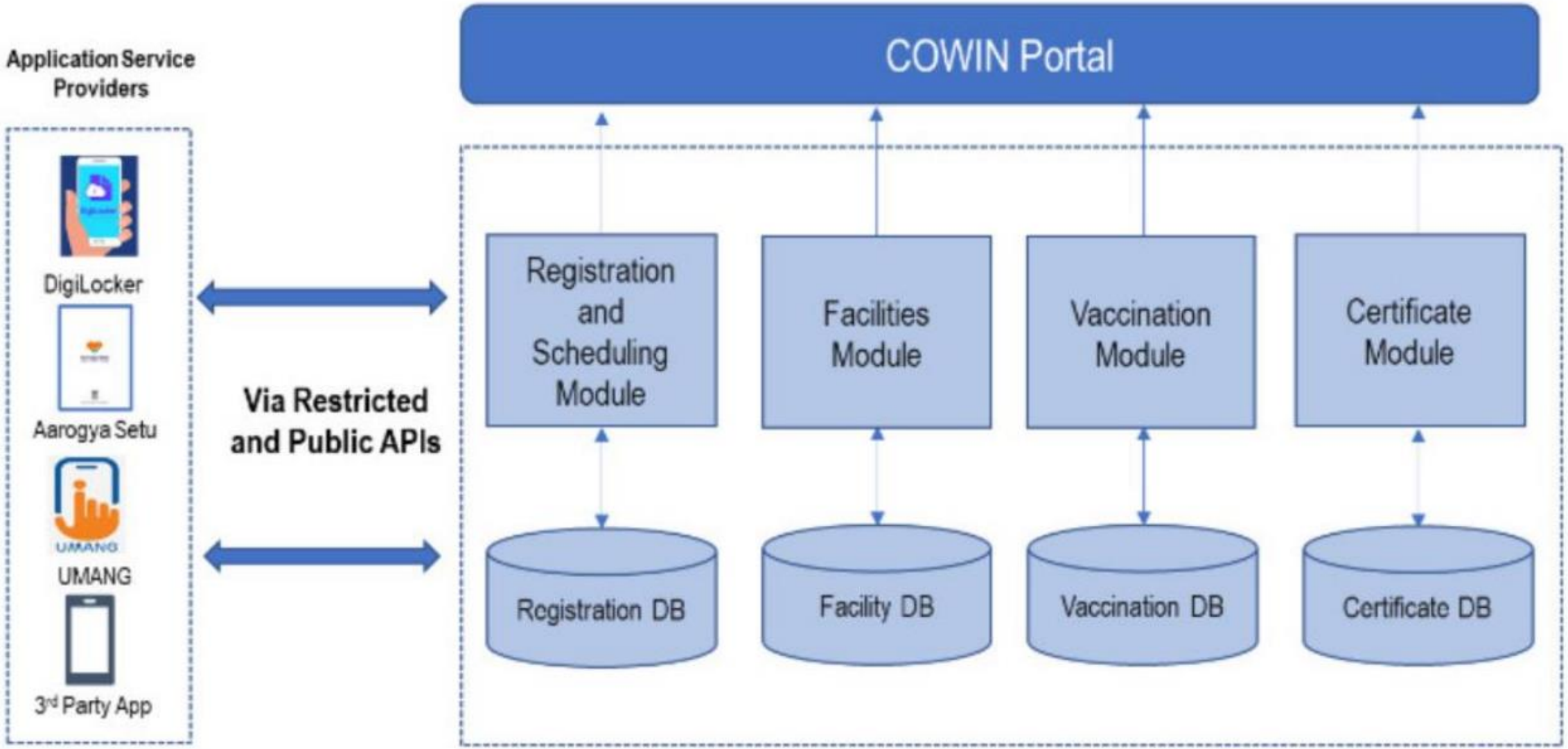
Customer Relationship Management

HubSpot
insightly
salesforce
Microsoft Dynamics 365
ZOHO
salesflare
engagebay
freshworks
pipedrive
monday.com

Full Pack Suite

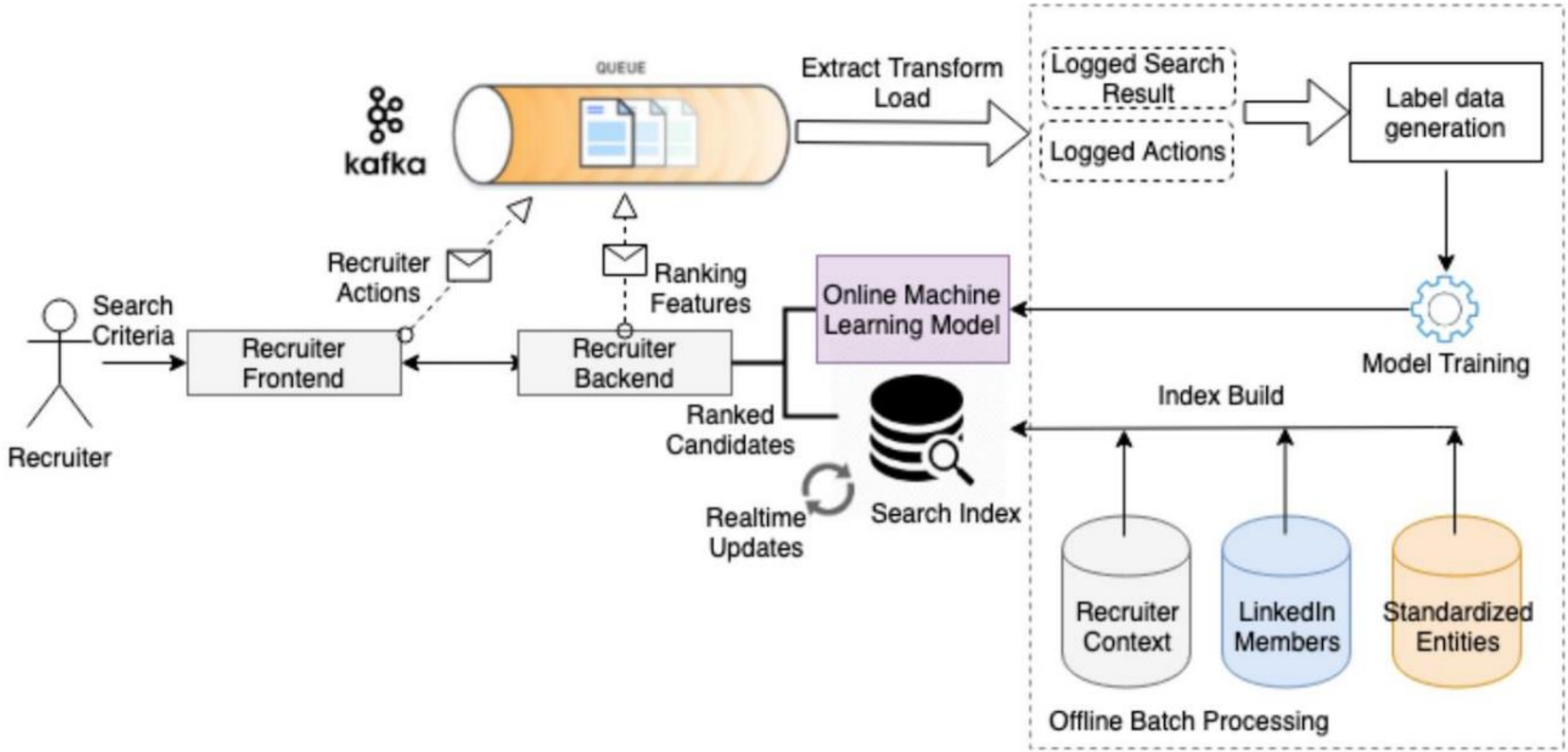
Azure
aws
ORACLE CLOUD
Alibaba Cloud
salesforce

COWIN – Mass Vaccination – India Stack



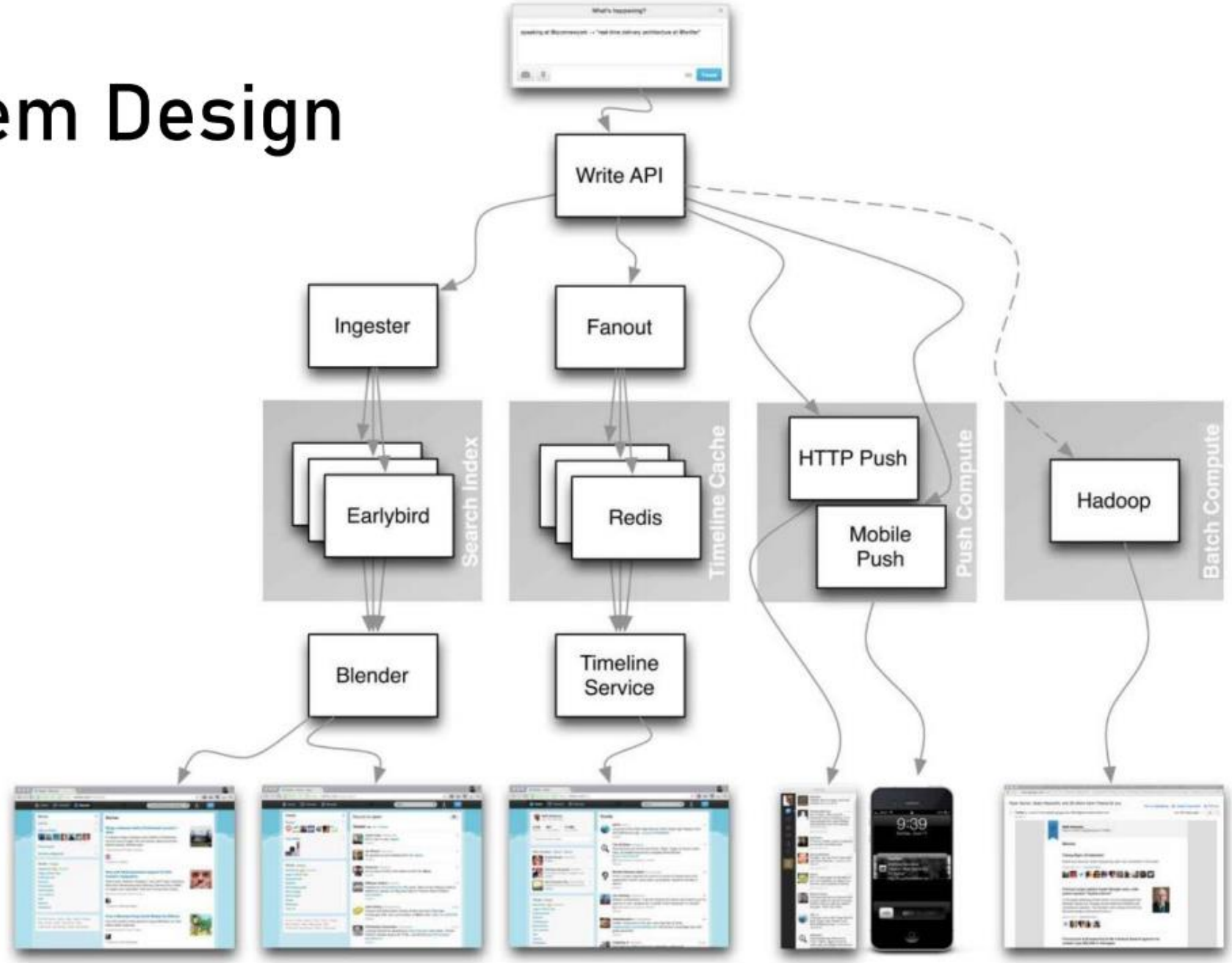
Source: https://apisetu.gov.in/document-central/cowin/Co-WIN%20API%20Guidelines.html

LinkedIn Recruiting Module



Source: https://engineering.linkedin.com/blog/2019/04/ai-behind-linkedin-recruiter-search-and-recommendation-systems

Twitter – System Design



Source: https://www.infoq.com/presentations/Twitter-Timeline-Scalability

UPI Payment Gateway – India Stack