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# Architecting Solutions for Enterprise and Nation: Challenges and Strategies



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# Abstract



Software architecture for an enterprise has been addressed extensively and the software engineering community understands the issues and challenges. Typical quality attributes that need to be addressed for enterprise architecture are modifiability, performance, security and usability. When we move to population scale some more attributes crop up. For example, Interoperability, Open Standards, Replaceability, Platform thinking etc.

This talk will start with software architecture, solution architecture, quality attributes and talk about principles of designing for the enterprise and designing for a nation(population scale).



## On Building IT Solutions

Not about writing code but about solving User problems  
Solution Architecture



## Architecture of Software

Quality Attributes, Patterns, Tactics



## Population Scale Systems

Strategies/ Quality attributes

# Solution Architecture

- The task is solving problems, not writing code.
- How much of the problem is addressed by the code is the main challenge

- In a bank, how does one verify the signature?

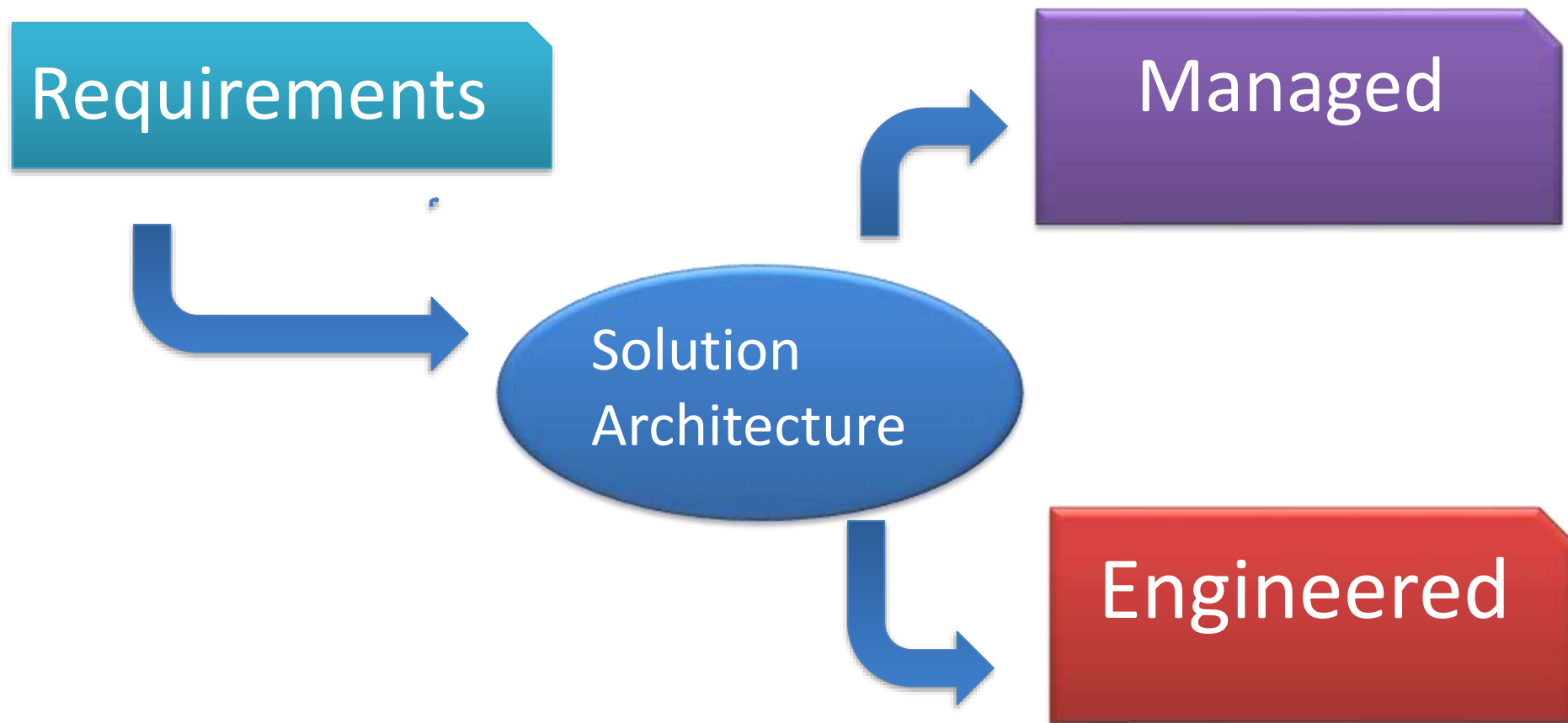
The computer system can be used to store the signature and when a verification is needed, retrieved from the database and presented to the user. Alternately, some image matching software can be used to verify the software.

- How does make sure that the book being taken out of the library is issued to the user?
  - Make a person check at the gate
  - Put a magnetic strip in the book binding and use a sensor
  - Don't check – live with some pilferage



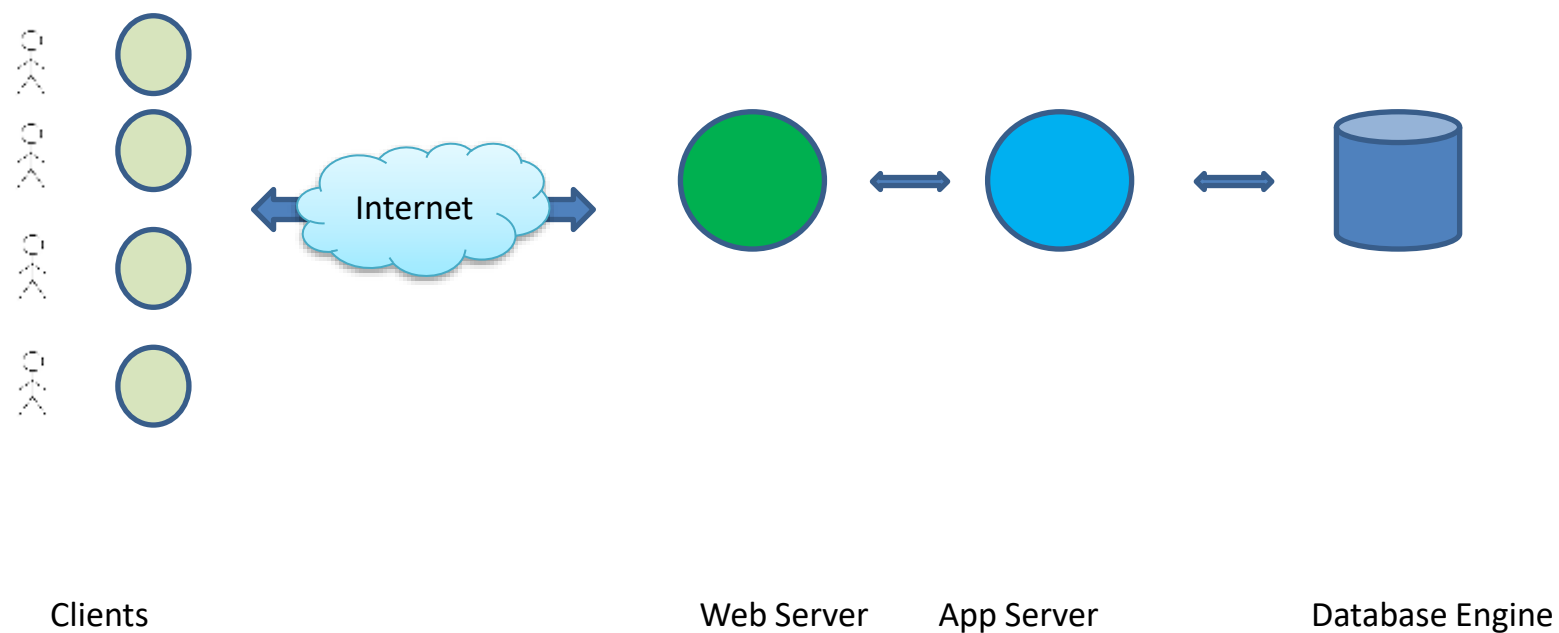
## Failover

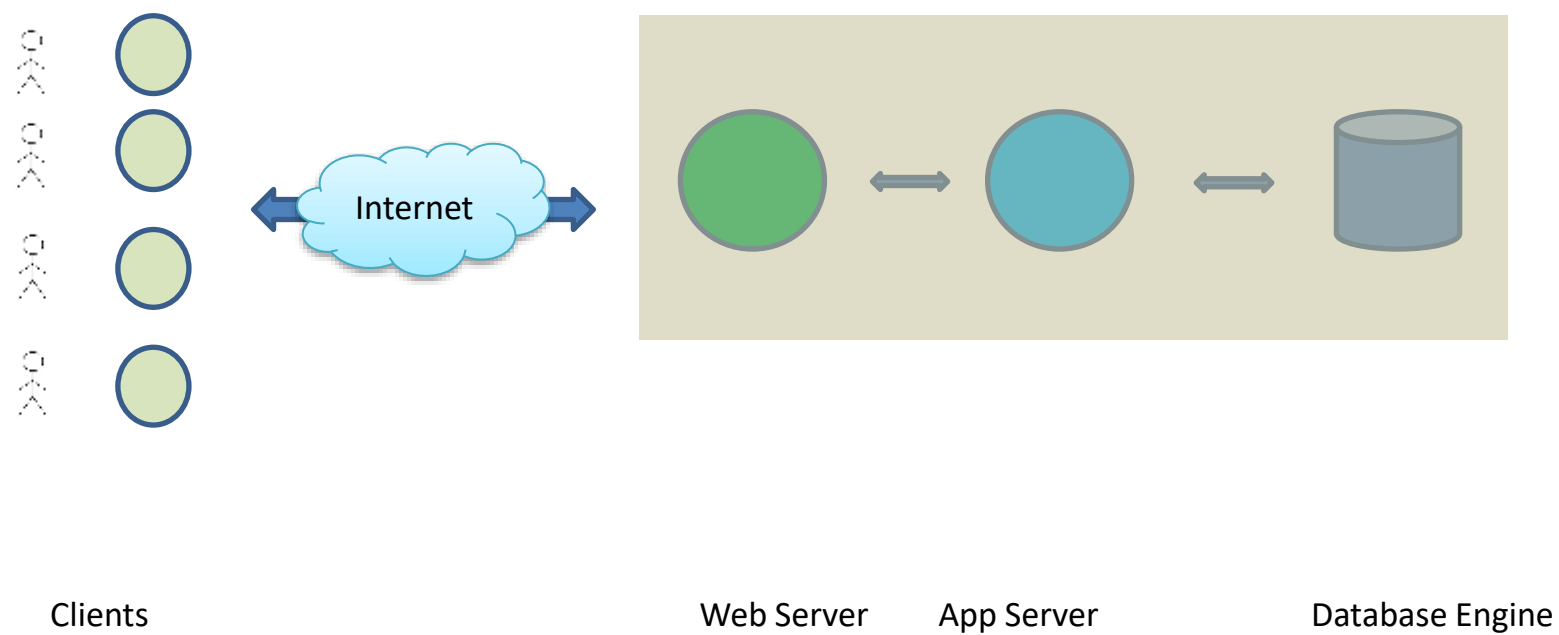
- A standby computer takes over upon a failure
- A 'hot standby' may double the costs or more
- Does the application need it?



- Divides the requirements into what is to be ‘engineered’ and what is to be ‘managed’
- Managed – to be done through processes, practices
- Engineered – through hardware, software – the reason we exist?
- Business goals to functional requirements

# What is Software Architecture?



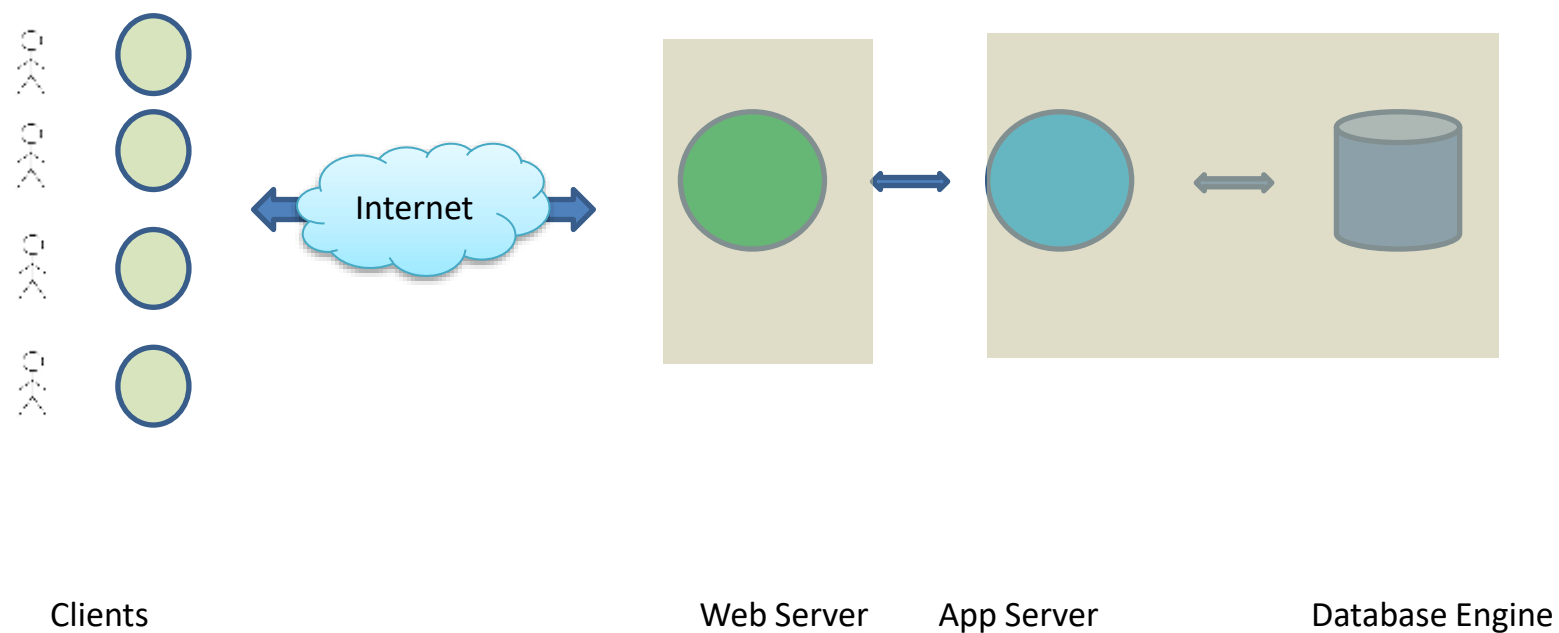


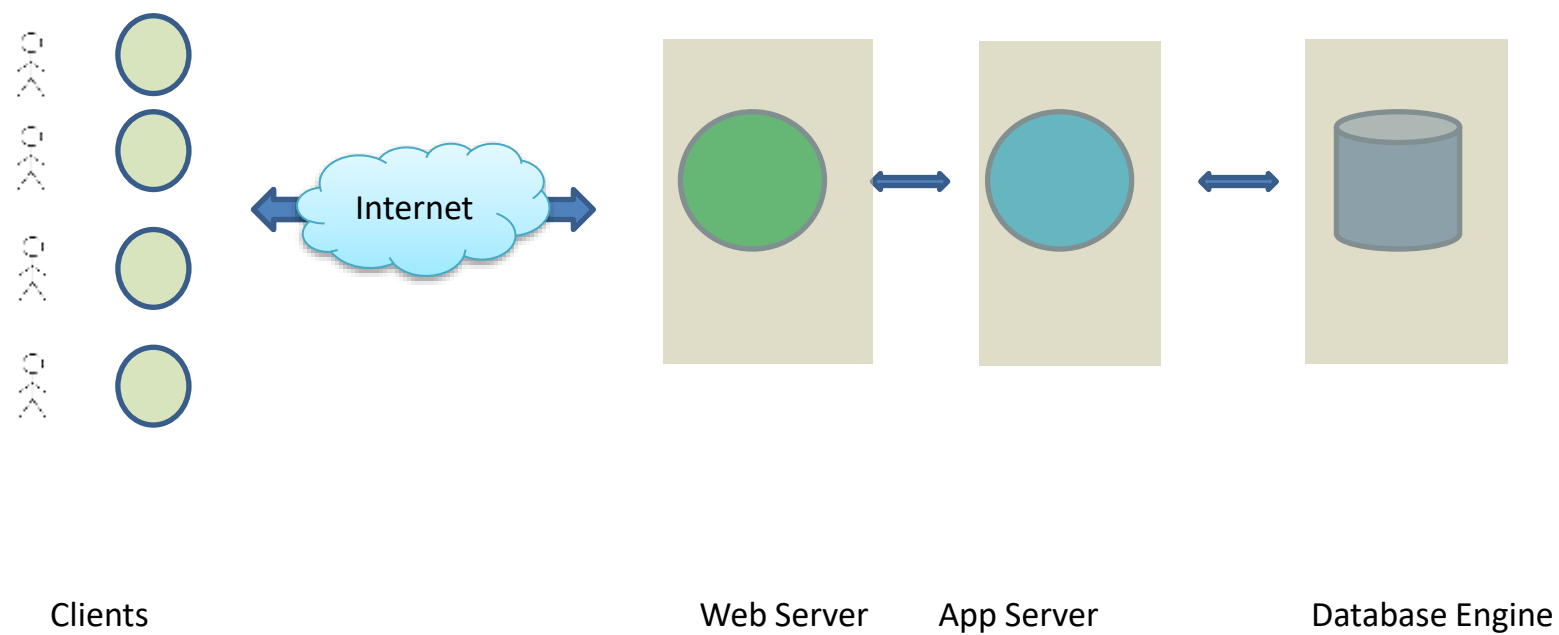
Clients

Web Server

App Server

Database Engine







# What is the difference in these deployments?

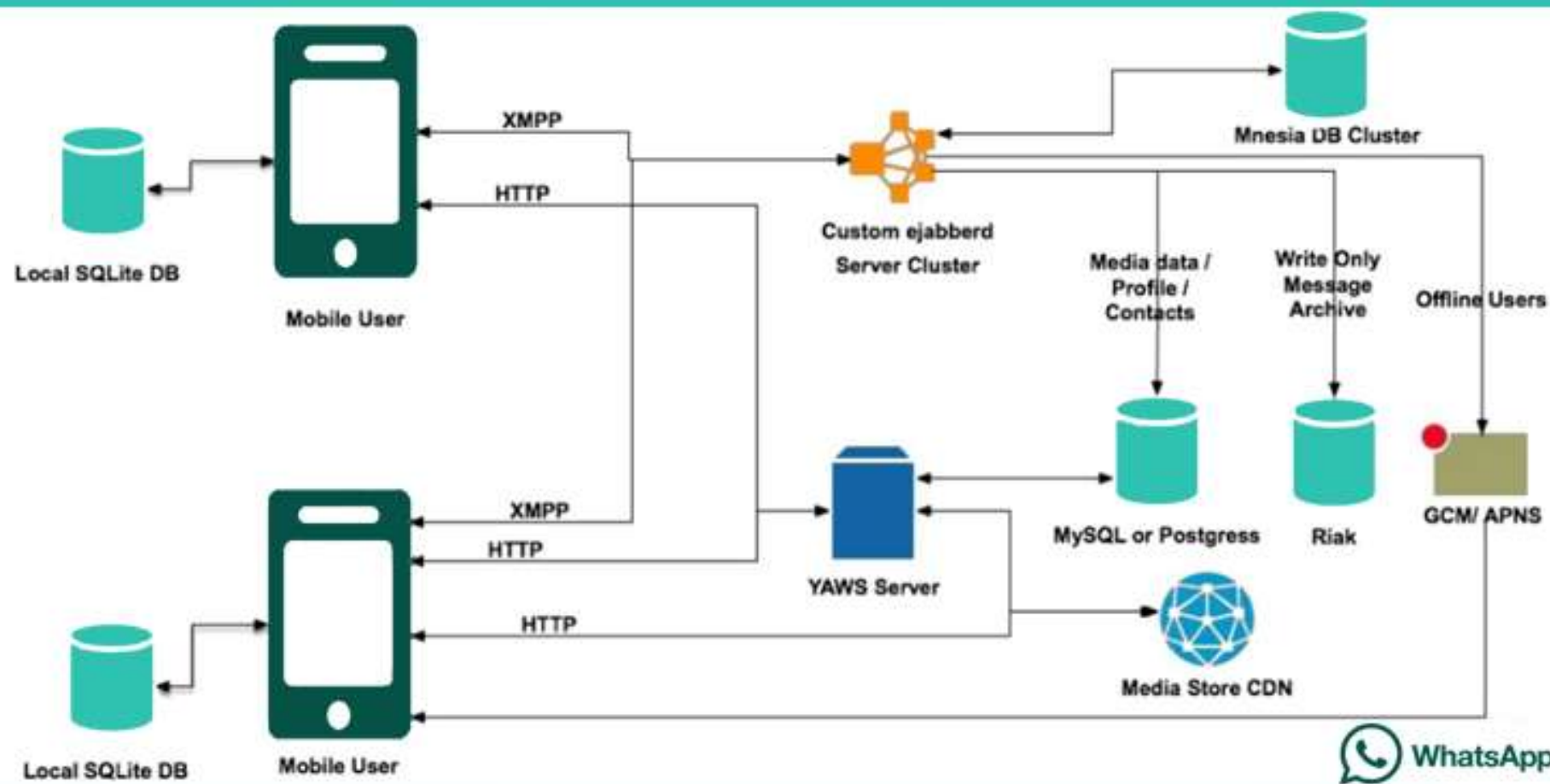


- No difference to the end user!
- But
  - Response times
  - Scalability
  - Disaster Recovery

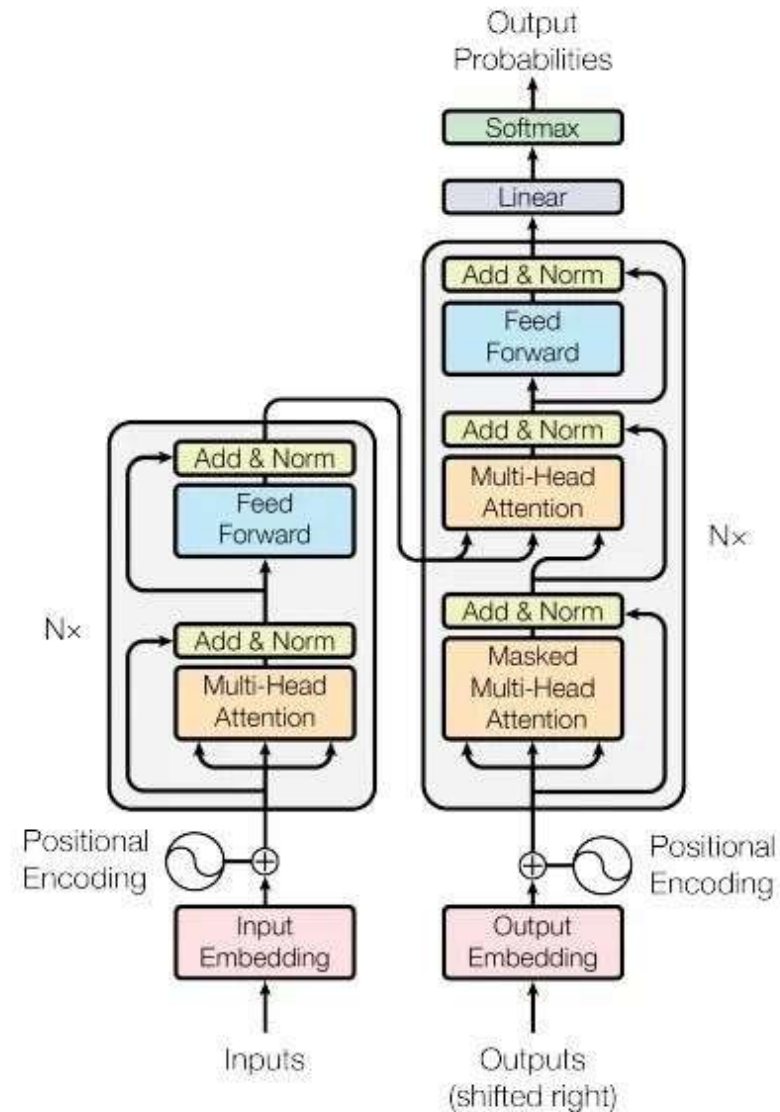
May be different

"Box and line" diagrams

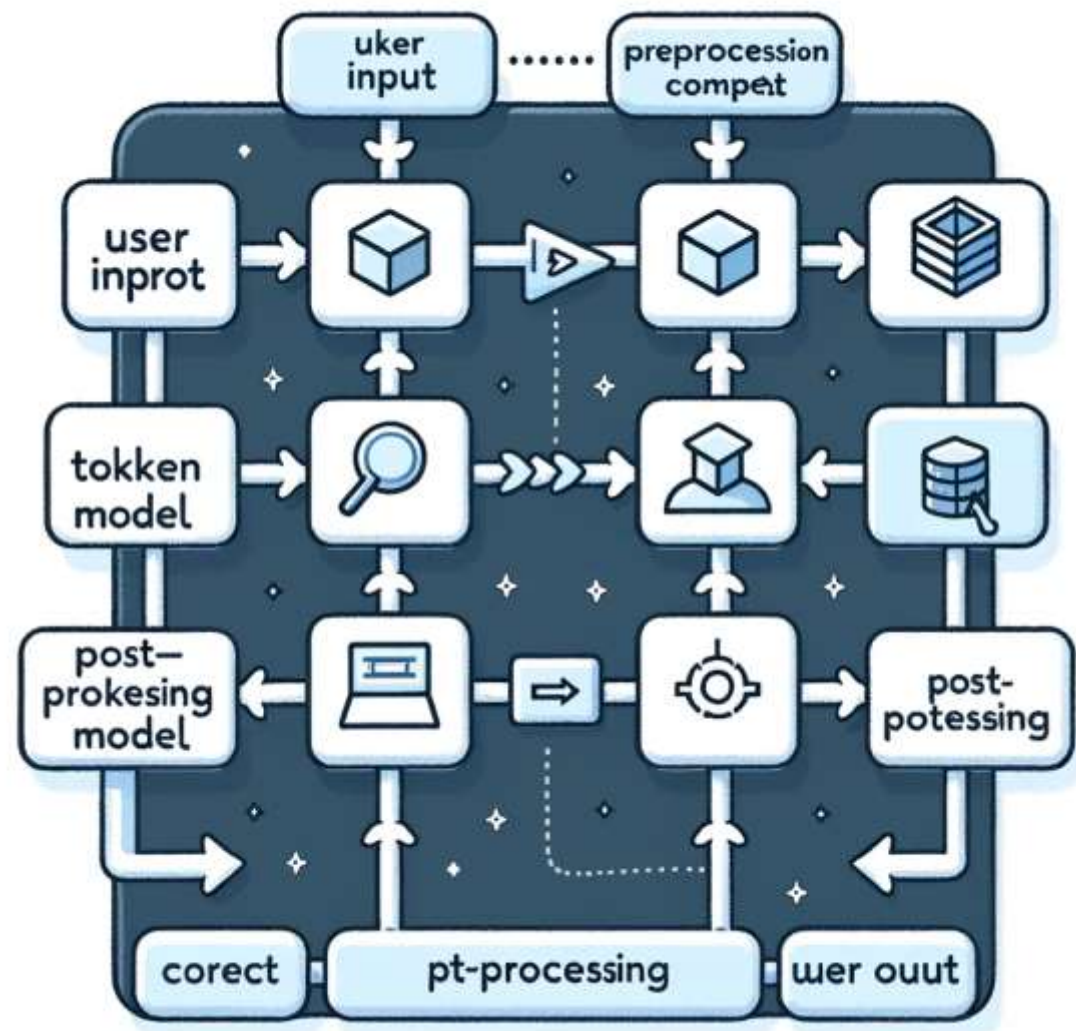
## Understanding WhatsApp architecture



# Chatgpt Architecture Vaswani 2017



# How Chatgpt works by Chatgpt



# Quality Attributes



# Requirements can be classified



- We build a system given some requirements
- Three kinds
  1. Functional Requirements
  2. Quality Attribute Requirements
  3. Constraints

# ISO 25010 Quality Models

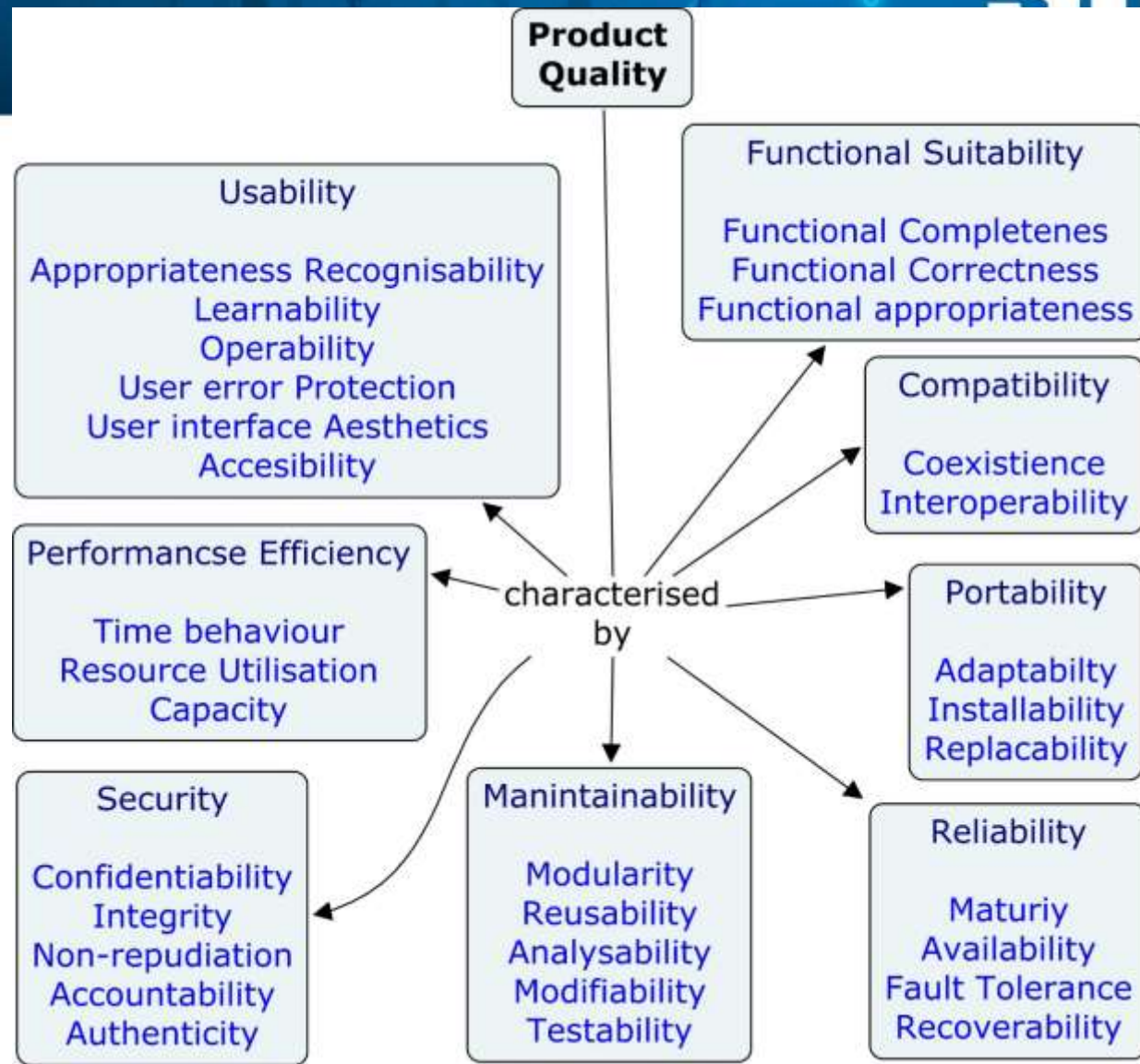
## quality in use model

- relates to the outcome of interaction when a product is used in a particular context of use.
- composed of five characteristics (and sub-characteristics)

## product quality model

- relates to static properties of software and dynamic properties of the computer system
- composed of eight characteristics (and sub-characteristics)

# ISO 25010





# How do we achieve these qualities?

- Addressed during architecture stage
- We follow some principles?
  - Separation of concerns
  - Reduce coupling, increase cohesion
  - Late Binding
  - Abstract
- Captured in the architecture
  - Follows design patterns, tactics

# How to architect?



# What if we want to build nation scale?

What are the quality attributes?  
What are the design principles?

# Building Applications that a whole country uses



- Building Roads
- Digital counterpart – Digital Highways
  
- How do we build these?



# First Principle for Population Scale



- Build roads, let others build cars
  - Build Digital highways, allow other to innovate
  - Digital Public Infrastructure
- 
- Internet, GPS

# Here are some

1. **Enable diversity**
2. **Open standards, open source**
3. **Long life span**
4. **Observability**
5. **Keep it simple**
6. **Resilience and Disaster Recovery**
7. Scalability and Performance
8. Security and Privacy
9. **Interoperability and Integration**
10. **Regulatory Compliance**



# What is Aadhar

- ✘ GPS – where am I
- ✘ Aadhar – who am I
- ✘ Foundational id vs Functional id
- ✘ Aadhar is Foundational, Driving license is Functional



# India Stack



Data



Payments - UPI



Digital locker - open protocol for distributed credential sharing



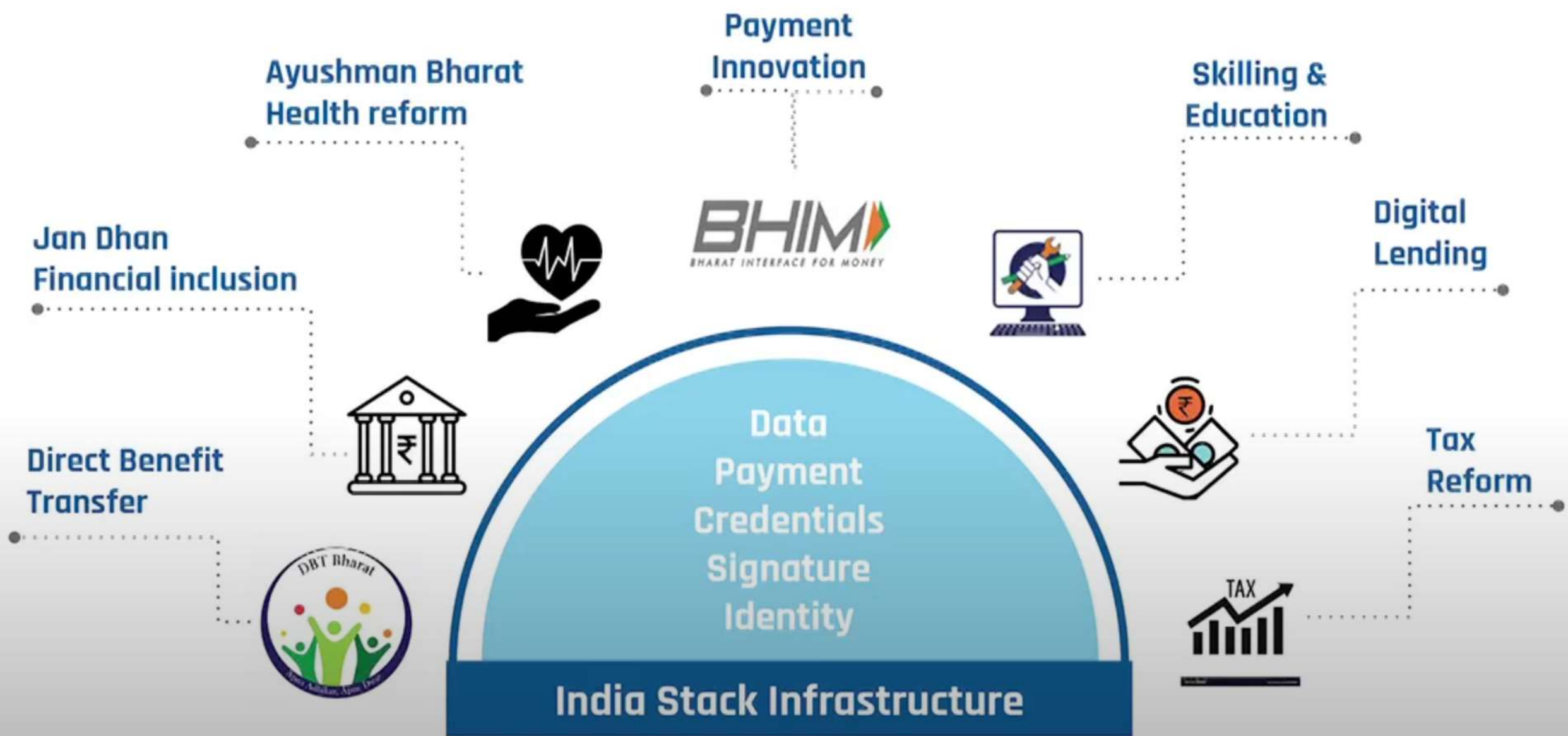
eSign - open protocol for Digital signature



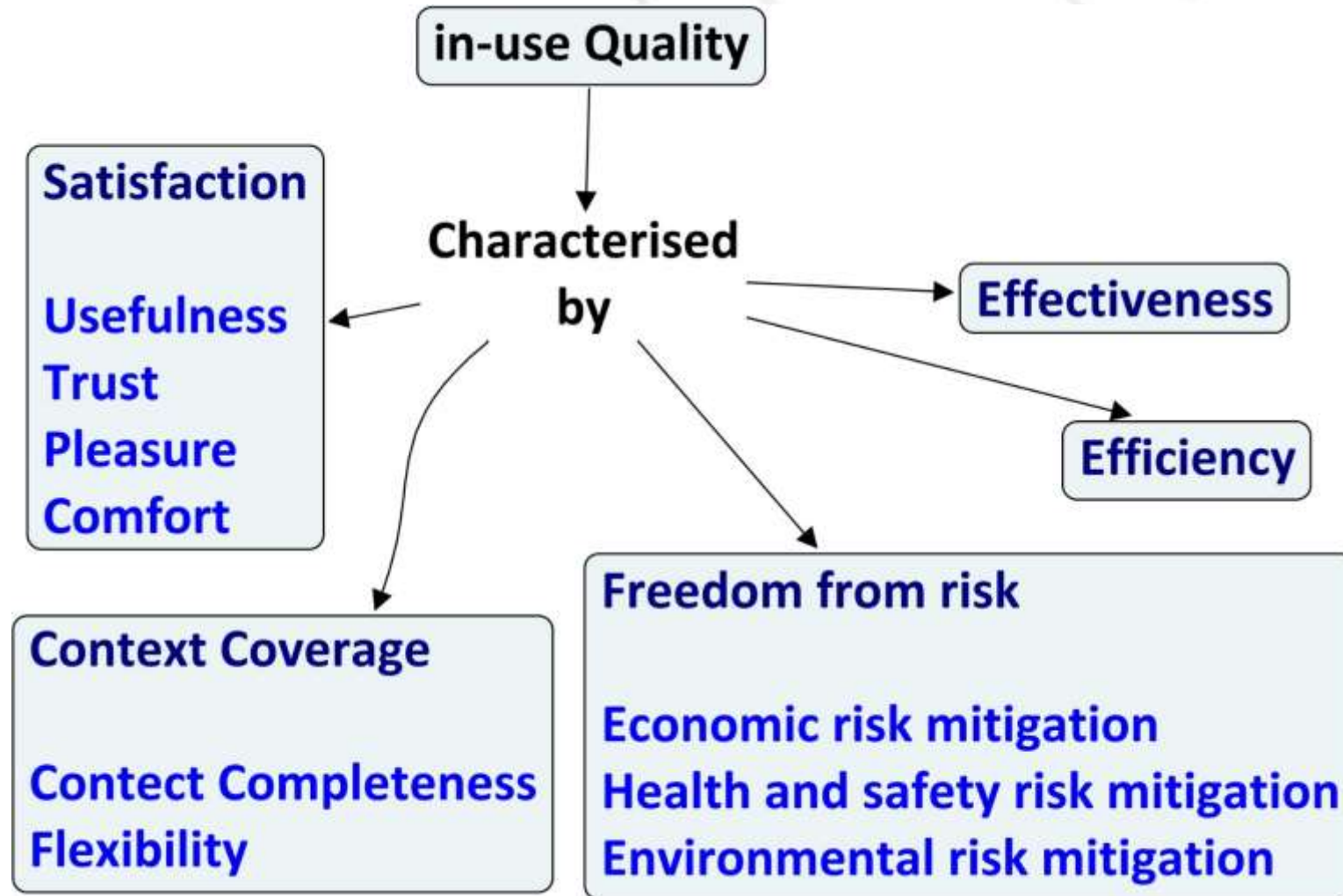
Identity - Fundamental, Minimal Unique, Lifetime, Gives a number and has two APIs. eKYC

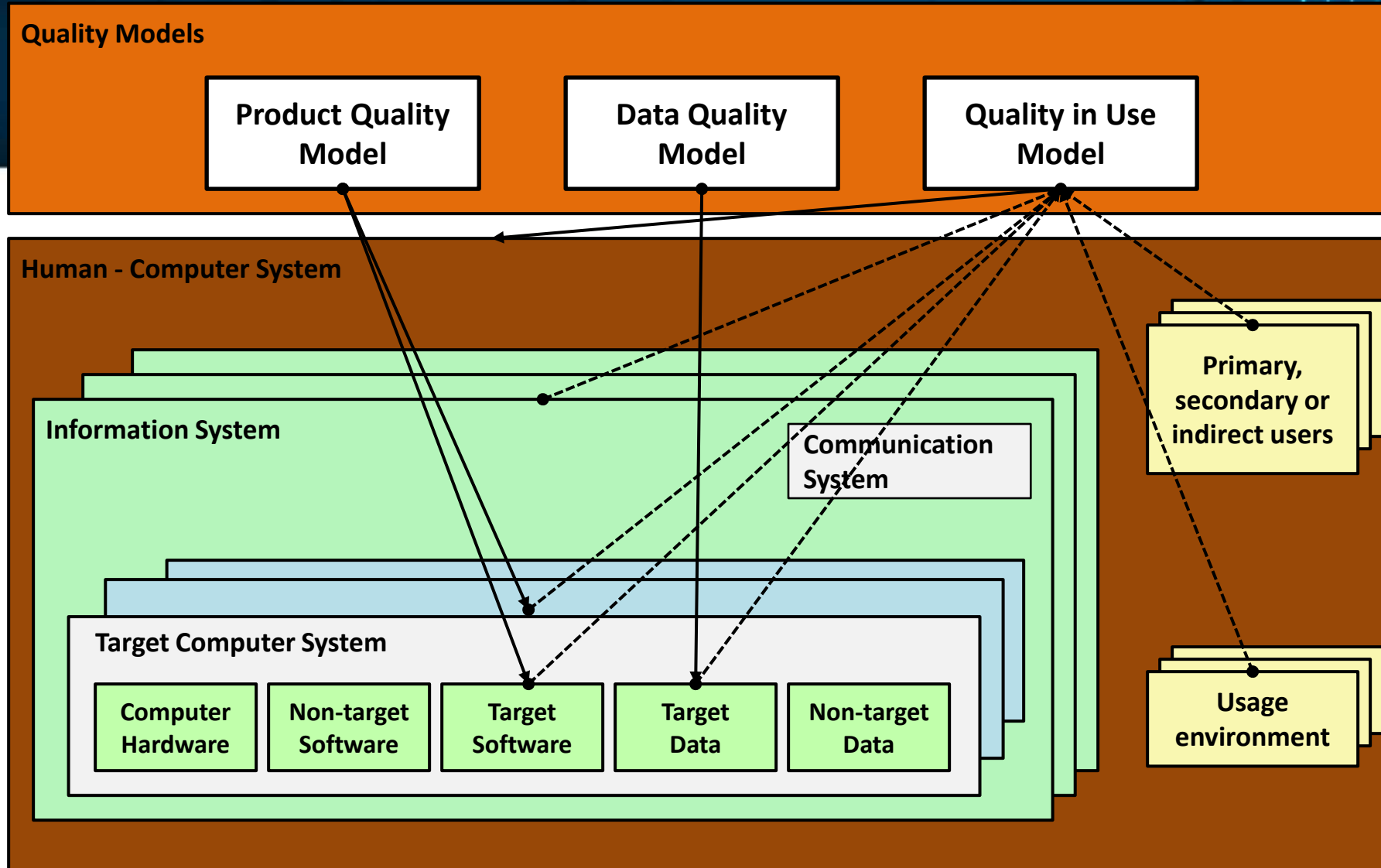


# INDIA STACK: shared digital infrastructure for creating innovative and inclusive solutions



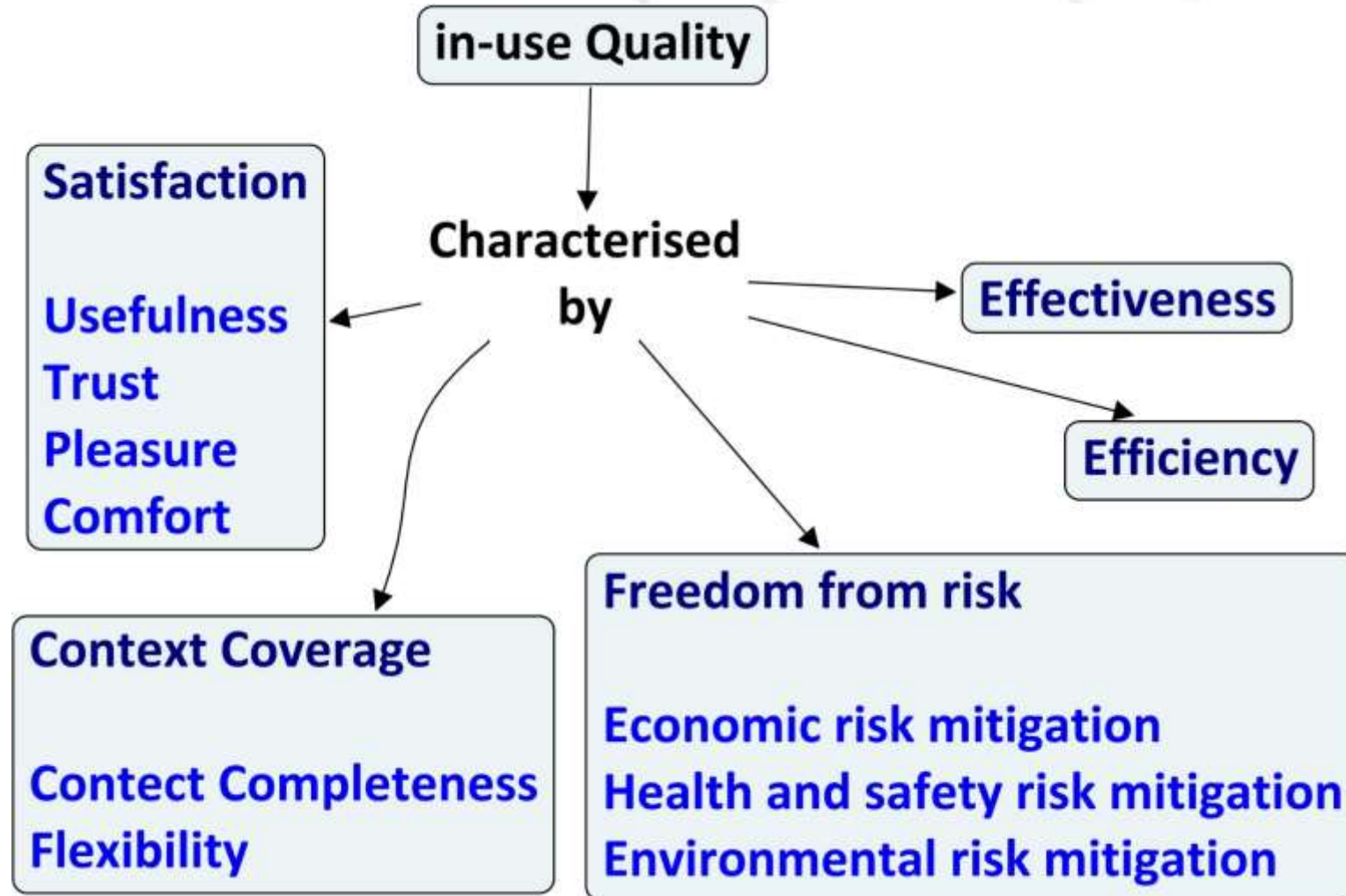
# ISO 25010

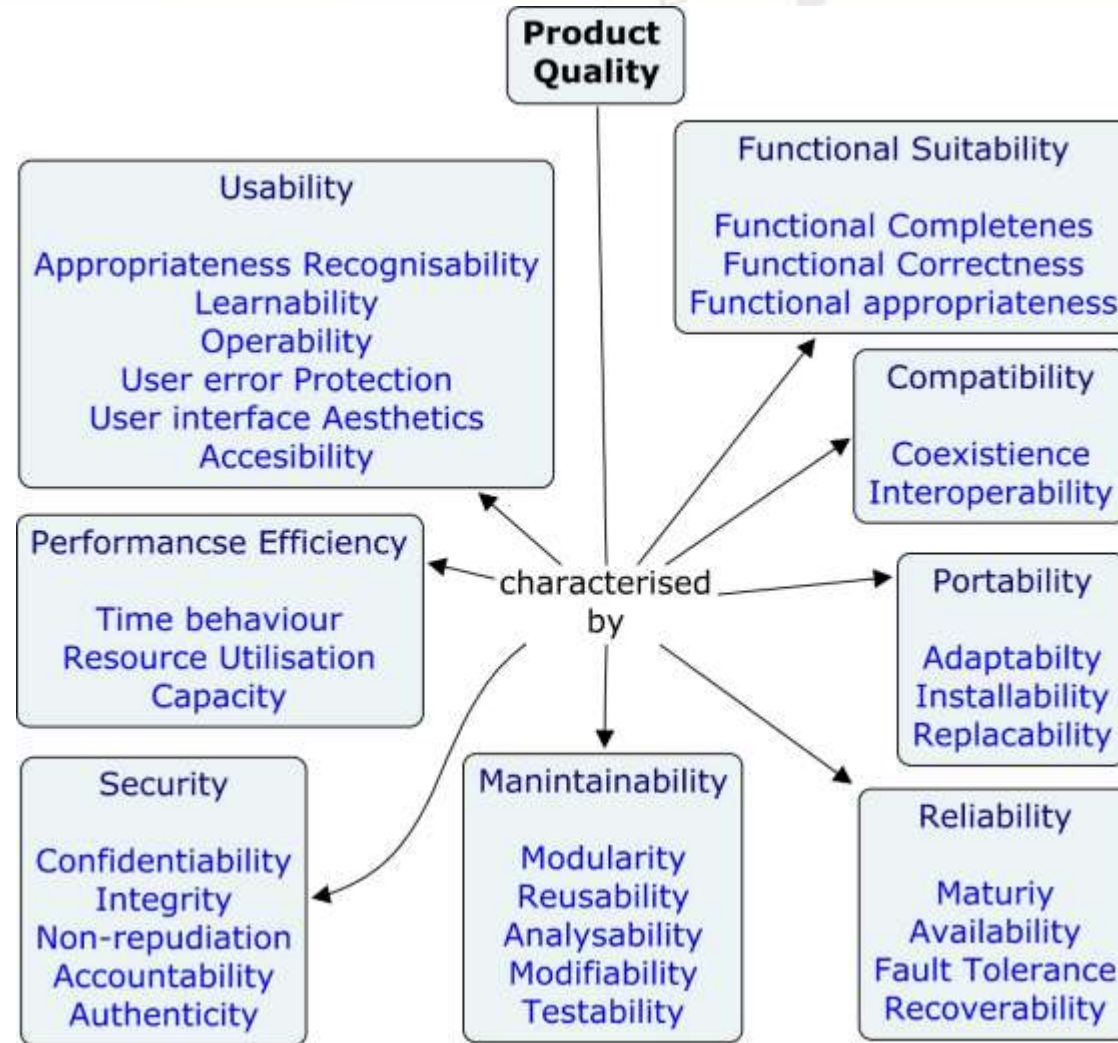




Key :

- ———> What is measured by the model :
- ← ———● Some of the factors that influence quality in use





# Thank You

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