Unit-5 Blockchain Application Development [Important Questions With Detailed Answers]

1. Hyperledger Fabric Architecture ⭐

Introduction

Hyperledger Fabric is an enterprise blockchain platform. It is mainly used by companies, banks and organizations.

Definition

Hyperledger Fabric is a **permissioned blockchain framework** used to build secure enterprise blockchain applications.

Why It Is Needed

Companies need blockchain with:

- Privacy
- Fast transactions
- Known users
- Access control
- Business smart contracts

Easy Explanation

Bitcoin is public, anyone can join. But Hyperledger Fabric is private. Only approved members can join.

Main Components

Component	Work
Client	Sends transaction request

Component	Work
Peer	Stores ledger and chaincode
Orderer	Orders transactions
Channel	Private communication path
Chaincode	Smart contract
MSP	Manages identities
Ledger	Stores blockchain records

Step-by-Step Working

1. Client sends transaction request.
2. Peer executes chaincode.
3. Endorsement is collected.
4. Orderer orders transactions.
5. Block is created.
6. Peers validate transaction.
7. Ledger is updated.

Diagram

```
Client
  ↓
Endorsing Peer → Chaincode
  ↓
Orderer
  ↓
Block Created
  ↓
Validation by Peers
  ↓
Ledger Update
```

Advantages

- High privacy
- Fast processing
- Permission-based access
- Suitable for enterprises
- Modular architecture

Disadvantages

- Complex setup
- Requires technical knowledge
- Not fully public like Bitcoin

Applications

- Banking
- Healthcare
- Supply chain
- Insurance
- Trade finance

Important Keywords

Permissioned blockchain, peer, orderer, chaincode, channel, ledger, MSP

Conclusion

Hyperledger Fabric is best for enterprise blockchain because it provides privacy, security and controlled access.

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2. Identities and Policies in Hyperledger Fabric ⭐

Definition

Identities are digital certificates used to identify users, and policies are rules that decide what users can do.

Easy Explanation

Like college ID card proves student identity, Fabric identity proves network member identity.

Why It Is Needed

It is needed to:

- Identify users
- Control access
- Prevent unauthorized activity
- Secure transactions

Working

1. Certificate Authority gives digital certificate.
2. User enters network using identity.
3. Policy checks permission.
4. Transaction is allowed or rejected.

Diagram

```
User
  ↓
Certificate Authority
  ↓
Digital Identity
  ↓
Policy Check
  ↓
Access Granted / Rejected
```

Types of Policies

Policy	Meaning
Endorsement Policy	Who must approve transaction
Access Policy	Who can access network
Admin Policy	Who can manage network

Advantages

- Strong authentication
- Better security
- Role-based permission
- Prevents fake users

Conclusion

Identities and policies make Hyperledger Fabric secure and enterprise-ready.

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3. Membership and Access Control ⭐

Definition

Membership and access control decide who can join the blockchain network and what work they can perform.

Easy Explanation

Not everyone gets same power. Admin, user and validator have different roles.

Working

1. User requests membership.
2. Identity is verified.
3. Role is assigned.
4. Permission is given.
5. User performs allowed operations only.

Diagram

```
User Request
    ↓
Identity Verification
    ↓
Role Assignment
    ↓
Access Permission
```

Advantages

- Prevents unauthorized users
- Improves privacy
- Gives role-based control
- Suitable for business networks

Disadvantages

- Needs proper management
- Less decentralization

Applications

- Banking blockchain
- Hospital records
- Government systems

Conclusion

Access control ensures only trusted and authorized users participate in the blockchain.

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4. Channels in Hyperledger Fabric ⭐

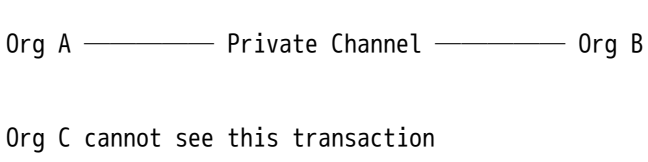
Definition

A channel is a private communication path between selected organizations in Hyperledger Fabric.

Easy Explanation

Suppose three companies are in one blockchain, but only two companies want private transaction. They create a separate channel.

Diagram



Working

1. Organizations create a channel.
2. Only channel members can access data.
3. Separate ledger is maintained.
4. Transactions remain private.

Advantages

- High privacy
- Separate ledger
- Confidential business deals
- Better data security

Disadvantages

- Channel management is complex
- More configuration required

Applications

- Private bank deals
- Business contracts
- Supply chain partnerships

Conclusion

Channels provide privacy by allowing selected members to share data privately.

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5. Transaction Validation in Hyperledger Fabric ⭐

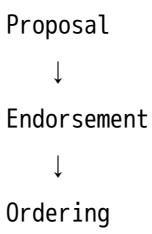
Definition

Transaction validation is the process of checking whether a transaction is correct before adding it to the ledger.

Step-by-Step Working

1. Client sends transaction proposal.
2. Endorsing peer simulates transaction.
3. Endorsement is returned.
4. Orderer orders transactions into block.
5. Peers validate endorsement policy.
6. Valid transaction is committed.
7. Invalid transaction is rejected.

Diagram



```
    ↓
Validation
    ↓
Ledger Commit
```

What is Checked?

- Digital signature
- Endorsement policy
- Transaction format
- Double spending/conflict

Advantages

- Prevents wrong transactions
- Maintains ledger accuracy
- Improves trust
- Ensures policy compliance

Conclusion

Transaction validation ensures only correct and approved transactions are stored in blockchain.

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6. Smart Contract using Hyperledger Fabric ⭐

Definition

In Hyperledger Fabric, smart contract is called **Chaincode**. It contains business rules.

Easy Explanation

Chaincode is like automatic business logic.

Example:

```
IF payment is done
THEN transfer product ownership
```

Working

1. Developer writes chaincode.
2. Chaincode is installed on peers.
3. Client sends transaction request.
4. Chaincode executes logic.
5. Ledger state changes.
6. Transaction is validated and committed.

Diagram

```
Client Request
    ↓
Chaincode Execution
    ↓
Business Rule Check
    ↓
Transaction Validation
    ↓
Ledger Update
```

Advantages

- Automation
- Less human error
- Secure business logic
- Faster processing

Applications

- Insurance claim
- Supply chain tracking
- Banking transactions
- Trade finance

Conclusion

Chaincode automates business rules in Hyperledger Fabric.

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7. Smart Contract using Ethereum ⭐

Definition

Ethereum smart contract is a self-executing program written mainly in Solidity and deployed on Ethereum blockchain.

Easy Explanation

Ethereum smart contract works automatically when conditions are fulfilled.

Simple Example

```
IF buyer pays money
THEN product ownership transfers automatically
```

Working

1. Contract is written in Solidity.
2. Contract is compiled.
3. Contract is deployed on Ethereum.
4. User calls contract function.

5. EVM executes code.
6. Result is stored on blockchain.

Diagram

```
Solidity Code
    ↓
Deploy on Ethereum
    ↓
User Interaction
    ↓
EVM Execution
    ↓
Blockchain Update
```

Advantages

- Decentralized
- Transparent
- Automatic execution
- No middleman

Disadvantages

- Gas fee required
- Bugs can cause loss
- Once deployed, hard to change

Applications

- DeFi
- NFT
- Voting
- Crowdfunding

- Token creation

Conclusion

Ethereum smart contracts are useful for building decentralized applications.

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8. Overview of Ripple ⭐

Definition

Ripple is a blockchain-based payment network designed for fast international money transfer.

Easy Explanation

Ripple mainly helps banks send money across countries quickly and cheaply.

Working

```
Bank A → Ripple Network → Bank B
```

Features

Feature	Explanation
RippleNet	Global payment network
XRP	Native digital asset
Fast Settlement	Transactions in seconds
Low Fee	Cheaper than traditional transfer

Advantages

- Fast international payment
- Low cost
- Useful for banks

- Better liquidity

Disadvantages

- More centralized than Bitcoin
- Depends on banking adoption

Applications

- Cross-border payments
- Bank settlement
- Remittance

Conclusion

Ripple is useful for fast and low-cost global financial transactions.

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9. Overview of Corda ⭐

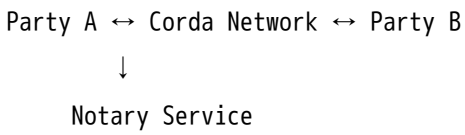
Definition

Corda is a distributed ledger platform designed for business and financial agreements.

Easy Explanation

Corda is different from public blockchain because it shares data only with involved parties.

Working



Features

Feature	Explanation
Permissioned	Only known users
Privacy-focused	Data shared only with parties
Smart Contracts	Business agreement logic
Notary	Prevents double spending

Advantages

- High privacy
- Enterprise friendly
- Legal agreement support
- Efficient data sharing

Disadvantages

- Less decentralized
- Mainly for enterprise use

Applications

- Banking
- Insurance
- Trade finance
- Legal contracts

Conclusion

Corda is suitable for businesses that need privacy and secure agreements.

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10. Hyperledger Fabric vs Ethereum ⭐

Basis	Hyperledger Fabric	Ethereum
Type	Permissioned	Mostly public
Users	Authorized users	Anyone can join

Basis	Hyperledger Fabric	Ethereum
Smart Contract	Chaincode	Solidity contract
Privacy	High	Low in public network
Speed	Faster	Slower
Currency	No native currency required	Ether required
Use	Enterprise apps	Decentralized apps
Example	Supply chain, banking	DeFi, NFT

Which is Better?

- **Hyperledger Fabric** is better for companies because it gives privacy and access control.
- **Ethereum** is better for public decentralized applications.

Conclusion

Fabric is enterprise-focused, while Ethereum is public smart-contract focused.

🔥 Most Important 7-Mark Questions

1. Explain Hyperledger Fabric architecture.
2. Explain identities and policies in Fabric.
3. Explain membership and access control.
4. Explain channels in Hyperledger Fabric.
5. Explain transaction validation in Fabric.
6. Explain chaincode in Hyperledger Fabric.
7. Explain Ethereum smart contract.
8. Explain Ripple.
9. Explain Corda.
10. Differentiate Hyperledger Fabric and Ethereum.

⭐ Most Important 14-Mark Questions

1. Explain Hyperledger Fabric architecture with transaction flow.
2. Explain identities, policies, membership and access control in Fabric.
3. Explain channels and transaction validation in Hyperledger Fabric.
4. Explain writing smart contracts using Hyperledger Fabric and Ethereum.
5. Compare Hyperledger Fabric and Ethereum in detail.
6. Explain Ripple and Corda with features and applications.

🎯 PYQ-Based Expected Questions

Very Important

- Hyperledger Fabric Architecture
- Transaction Validation
- Chaincode / Smart Contract
- Ethereum Smart Contract
- Channels

High Probability

- Identities and Policies
- Membership and Access Control
- Ripple
- Corda

Medium Probability

- Hyperledger Fabric vs Ethereum

⚡ One-Night Revision

```
Hyperledger Fabric = Permissioned enterprise blockchain

Chaincode = Smart contract of Fabric

Channel = Private communication path

MSP = Manages identity

Orderer = Orders transactions

Peer = Stores ledger and executes chaincode

Ethereum = Public smart contract platform

Ripple = Fast international payments

Corda = Business privacy platform
```

📌 Smart Study Plan

First study:

1. Hyperledger Fabric Architecture
2. Transaction Validation
3. Chaincode
4. Ethereum Smart Contract

Then study:

1. Channels
2. Identities and Policies
3. Membership and Access Control

Last revise:

1. Ripple
2. Corda

3. Fabric vs Ethereum

🧠 Memory Tricks

```
Fabric = Private + Permission + Enterprise

Ethereum = Public + Smart Contract + DApps

Ripple = Bank Payment Fast

Corda = Business Privacy

Transaction Flow:
Proposal → Endorsement → Ordering → Validation → Commit
```

Final exam writing order:

```
Definition → Need → Diagram → Working → Advantages → Applications → Conclusion
```