Dr.SNS RAJALAKSHMI COLLEGE OF ARTS AND SCIENCE
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Coimbatore- 49

DEPARTMENT OF COMMERCE WITH INFORMATION TECHNOLOGY

21UCI505 – BLOCKCHAIN AND DISTRIBUTIVE LEDGER

Unit-3: Scalability Aspects of Blockchain Consensus Protocols

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Consensus Protocol

A **consensus protocol** is a set of rules used in distributed systems (especially blockchain networks) to help all participating nodes agree on a single version of data or transactions without a central authority.

In simple words, it ensures that **everyone in the network agrees on what is true**, even if some participants are faulty or malicious.

Scalability Aspects of Blockchain Consensus Protocols

Scalability in blockchain refers to the ability of the network to handle an increasing number of transactions, users, and nodes without performance degradation. It is one of the biggest challenges faced by platforms like Bitcoin and Ethereum.

What Does Scalability Mean?

A scalable blockchain should:

- Process **more transactions per second (TPS)**
- Maintain **low latency (fast confirmation time)**
- Keep **transaction fees low**
- Maintain **security and decentralization**

Key Scalability Aspects of Blockchain Consensus Protocols

1. Transaction Throughput (TPS)

Definition:

Number of transactions processed per second.

Examples:

Bitcoin → ~7 TPS

Ethereum → ~15–30 TPS (before scaling upgrades)

Issue:

Traditional systems like Visa handle thousands of TPS, but many blockchain networks handle much less.

Impact of Consensus:

Proof of Work → Slower

Proof of Stake → Faster

Key Scalability Aspects of Blockchain Consensus Protocols

2. Latency (Confirmation Time)

Definition:

Time taken to confirm a transaction.

Bitcoin → ~10 minutes per block

Ethereum → ~12 seconds per block

Scalability Concern:

Long confirmation times reduce usability for real-time applications.

Key Scalability Aspects of Blockchain Consensus Protocols

3. Block Size and Block Time

Block Size

Larger blocks = more transactions per block
But large blocks:
Increase storage requirements
Reduce decentralization

Block Time

Shorter block time = faster confirmations
But too short:
Increases forks
Reduces stability

Key Scalability Aspects of Blockchain Consensus Protocols

4. Consensus Mechanism Efficiency

Different consensus protocols affect scalability differently:

Proof of Work (PoW)

High security

Low scalability

High energy consumption

Proof of Stake (PoS)

Better scalability

Energy efficient

Faster validation

Delegated Proof of Stake (DPoS)

High TPS

More centralized

Key Scalability Aspects of Blockchain Consensus Protocols

5. Network Size (Node Participation)

As the number of nodes increases:

Communication overhead increases

Validation time increases

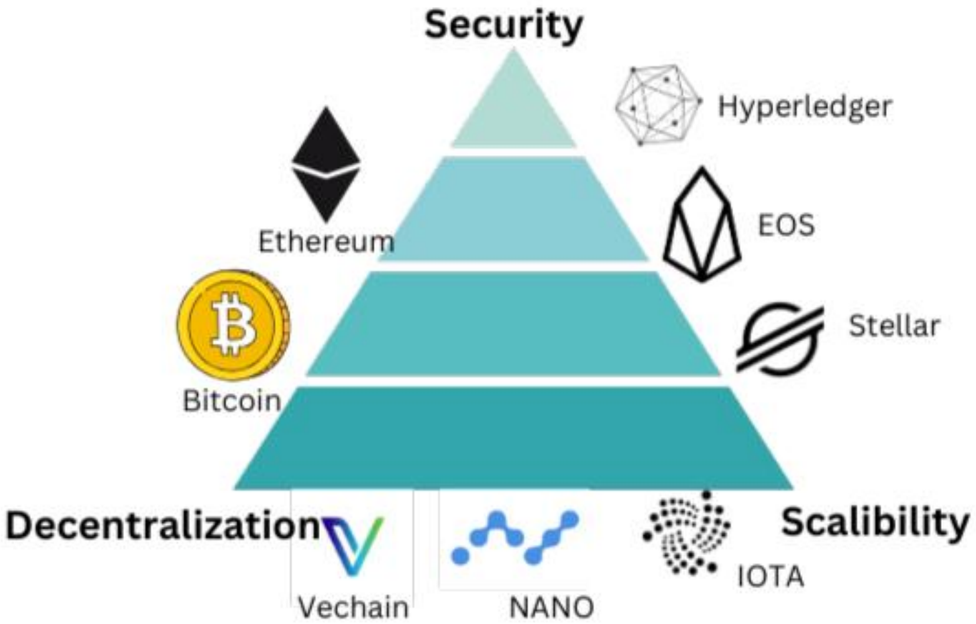
In protocols like PBFT:

Communication grows exponentially

Not suitable for large public networks

Key Scalability Aspects of Blockchain Consensus Protocols

6. The Blockchain Trilemma



Key Scalability Aspects of Blockchain Consensus Protocols

7. Layer 2 Scaling Solutions
To improve scalability without changing core consensus:
Lightning Network (for Bitcoin)
Rollups and sidechains (for Ethereum)

These:
Process transactions off-chain
Reduce network congestion
Increase TPS

Key Scalability Aspects of Blockchain Consensus Protocols

8. Sharding

Definition:

Dividing the blockchain into smaller parts (shards) to process transactions in parallel.

Benefits:

Increases throughput

Reduces node burden

Challenge:

Maintaining security across shards

THANK YOU