

2. Blockchain Technology – S & T

India is accelerating its adoption of blockchain technology to transform governance, enhance transparency, and strengthen digital trust through the National Blockchain Framework (NBF)

Blockchain Technology – Overview

1. Definition and Core Concept

Blockchain is a distributed, transparent, and tamper-resistant digital ledger that records transactions across a network of computers (nodes). It ensures data integrity, traceability, and immutability, meaning once data is entered, it cannot be altered or deleted without consensus. Each transaction is stored in a block linked to the previous one, forming a continuous chain – hence the term blockchain.

2. Key Features

Decentralization – Data is not stored on a single server but shared across a network.

Transparency – Every transaction is verifiable by network participants.

Immutability – Once validated and added to the chain, data cannot be changed.

Security – Uses cryptographic methods for transaction verification and user authentication.

Consensus Mechanisms – Ensures that all nodes agree on the validity of a transaction (e.g., Proof of Work, Proof of Stake).

Types Of Blockchains

1. Public Blockchain

Fully decentralized; anyone can join, read, write, and validate transactions.

Example – Bitcoin, Ethereum.

Use Case – Cryptocurrency, public records, and open data ecosystems.

2. Private Blockchain

Controlled by a single organization or entity.

Only authorized participants can access and validate data.

Use Case – Enterprise and government record management systems.

3. Consortium Blockchain

Semi-decentralized; managed by a group of organizations that share authority.

Enhances trust among multiple institutions collaborating on shared data.

Use Case – Banking consortia, supply chain partnerships, inter-governmental data sharing.

4. Hybrid Blockchain

Combines both public and private blockchain features.

Allows selective data access – sensitive information remains private, while general information remains public.

Use Case – Healthcare, land registry, and e-governance.

Blockchain In Governance

1. National Blockchain Framework (NBF)

Launched – 2024 by the Ministry of Electronics and Information Technology (MeitY).

Budget Outlay – ₹64.76 crore.

Objective –

1. To promote the development and deployment of permissioned blockchain-based governance applications.
2. To create a secure, transparent, and interoperable digital infrastructure for India's governance systems.
3. To align blockchain use with Digital India and e-Governance initiatives.

Key Components Of NBF

1. Vishvasya Blockchain Stack

Purpose – An indigenous, modular platform providing the technical backbone for blockchain-based applications in governance.

Key Features –

Blockchain-as-a-Service (BaaS) – Offers a ready-made, cloud-based platform to build blockchain apps. Enables departments to use blockchain without maintaining their own complex infrastructure.

Distributed Infrastructure – Deployed across NIC Data Centres in Bhubaneswar, Pune, and Hyderabad. Ensures fault tolerance, scalability, and high availability.

Permissioned Blockchain Layer – Ensures only verified entities (like government departments, certified agencies) can validate or participate.

Open APIs and Integration Services – Facilitates seamless data exchange between existing government systems and blockchain-based applications.

2. NBFLite – Blockchain Sandbox

Purpose – Provides a **sandbox testing environment** for **startups, academic institutions, and research bodies**.

Function – Allows experimentation, prototyping, and innovation in blockchain applications. Focus on governance-related use cases like property records, certifications, and identity verification.

Impact – Encourages public-private collaboration in blockchain research and implementation.

3. Praamaanik

A blockchain-based mobile application verification tool.

Objective – Ensures the authenticity, security, and traceability of mobile apps in government and public usage.

Significance – Prevents circulation of fake or malicious applications and enhances digital trust.

Blockchain-Enabled Governance Applications

1. Certificates and Document Chain

Enables secure issuance and retrieval of essential documents such as –

1. Academic certificates
2. Caste and income certificates
3. Ration cards
4. Driving licenses
5. Birth and death certificates

Impact – Prevents document forgery, enables easy verification, and promotes paperless governance.

2. Logistics Chain

Provides a tamper-proof and transparent mechanism to track goods through every stage of supply.

Example – Karnataka's Aushada system tracks medicines from production to delivery, verifying –

1. Quality standards
2. Expiry date
3. Distribution authenticity

Outcome – Reduces counterfeit drug circulation and ensures product traceability.

3. Property Chain

Digitizes land and property transaction records on blockchain to ensure transparency and dispute-free ownership. Facilitates real-time verification of ownership, rights, and transfers. Reduces corruption, delays, and fraudulent transactions in land registries.

4. Judiciary Chain

Supports the electronic delivery of legal documents such as summons, notices, and bail orders.

Eliminates dependency on manual processing, thus reducing delays. Integrated with the Inter-Operable Criminal Justice System (ICJS) to ensure –

1. Unified case records,
2. Chain of custody for digital evidence,

3. Transparency in judicial document flow.

Blockchain Adoption Initiatives in India

1. Centre of Excellence in Blockchain Technology (NIC)

Provides consultancy, capacity building, and pilot support for government departments. Uses open-source blockchain frameworks like –

1. Hyperledger Fabric
2. Hyperledger Sawtooth
3. Ethereum

Encourages inter-departmental and inter-state collaboration for blockchain-based governance projects.

2. Reserve Bank of India (RBI)

Leveraging blockchain to power the Central Bank Digital Currency (CBDC) or Digital Rupee.

Objective – To promote secure, traceable, and inclusive digital transactions with minimal fraud.

3. Telecom Regulatory Authority of India (TRAI)

Integrated Distributed Ledger Technology (DLT) to track SMS communications. Ensures compliance with regulations and prevents spam or phishing messages. Strengthens consumer protection through transparent sender identification.

4. National Securities Depository Limited (NSDL)

Launched a DLT-based platform for Debenture Covenant Monitoring in capital markets. Enhances transparency and efficiency in monitoring corporate debt instruments. Reduces manual errors and ensures real-time regulatory compliance.

Ongoing And Emerging Proof of Concepts (POCS)

Land Records Chain – For secure and tamper-proof ownership records.

Blood Bank Chain – To ensure traceable and ethical blood donation and storage.

GST Chain – For real-time tax reporting and fraud detection.

Public Distribution System (PDS) Chain – To track ration distribution, prevent leakages, and improve accountability.

Significance Of Blockchain for Governance

Transparency – Every transaction is verifiable, reducing corruption and malpractice.

Trust – Builds public confidence in digital governance by making systems tamper-proof.

Efficiency – Eliminates intermediaries, reducing time and administrative costs.

Accountability – Enhances record authenticity and institutional responsibility.

Security – Protects sensitive data using cryptography and distributed consensus mechanisms.

Conclusion

Blockchain represents a foundational technology for “Trust-as-a-Service” in India’s digital ecosystem. The National Blockchain Framework (NBF) and Vishvasya Stack are laying the groundwork for secure, interoperable, and transparent governance applications. As pilot projects expand, India is moving toward a trust-based, digitally verified governance model, reinforcing the principles of Digital India and Minimum Government, Maximum Governance.

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