

Samādhāna

Blockchain-Based Public Procurement Payment System
for MSMEs using NBF Lite and Digital Rupee

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Disclaimer: This whitepaper proposes a conceptual solution for the Blockchain India Challenge. Technical feasibility is based on available public information about NBF Lite and Digital Rupee pilots. Actual implementation would require coordination with MeitY, RBI, MSME Ministry, and participating government departments.

Abstract

Samādhāna (Sanskrit: *samādhāna*, meaning "resolution" or "settlement") proposes a permissioned blockchain solution to address the chronic problem of delayed payments to Micro, Small and Medium Enterprises (MSMEs) in public procurement. The system leverages India's indigenous NBF Lite framework built on Hyperledger Fabric and integrates with the Reserve Bank of India's Digital Rupee (e-) Central Bank Digital Currency (CBDC) to create an automated, transparent, and auditable payment mechanism.

The solution addresses a critical governance challenge: despite legislative mandates under the MSMED Act, 2006 and recent amendments to the Income Tax Act, MSMEs continue to face payment delays averaging 60–90 days beyond the statutory 45-day limit. Samādhāna creates a "single source of truth" for procurement documents—Purchase Orders, Invoices, and Goods Receipt Notes—on a tamper-proof ledger, with smart contracts automatically triggering programmable e- payments upon verified acceptance of goods.

This whitepaper presents a technically feasible solution aligned with the objectives of the Blockchain India Challenge, utilizing nationally developed infrastructure. The initial scope focuses on domestic public procurement payments, with future extensions for cross-border trade and supply chain finance.

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1 Introduction and Problem Statement

1.1 Context: The MSME Payment Challenge

India's MSME sector constitutes the backbone of the national economy, contributing approximately **30.1% to the country's Gross Value Added (GVA)** and accounting for **45.73% of total exports** [1]. With over **7.16 crore registered MSMEs** employing more than **31.33 crore people** [2], the sector's financial health directly impacts India's economic growth trajectory.

Despite its critical importance, the sector faces a persistent structural bottleneck: **delayed payments in public procurement**. Government departments and Public Sector Undertakings (PSUs) represent the largest buyers in the economy, but payment cycles frequently extend 60–90 days beyond the mandated timelines, creating severe working capital stress for MSMEs.

1.2 Legislative Framework and Compliance Gap

The Government of India has enacted strong legislative measures to address this problem:

1. **MSMED Act, 2006**: Section 15 mandates that payments to micro and small enterprises must be made within **45 days** of acceptance of goods or services. The Act provides for compound interest on delayed payments [3].
2. **Income Tax Act Amendment (Finance Act, 2023)**: Section 43B(h) makes payments to MSMEs within the 45-day period a prerequisite for tax deduction eligibility, creating a strong fiscal compliance incentive.
3. **MSME Samādhān Portal**: An online delayed payment monitoring system established by the Ministry of MSME for grievance redressal [3].

However, **implementation remains inconsistent**. The existing monitoring framework is reactive—dependent on MSMEs filing complaints—and lacks proactive, real-time visibility into payment pipelines. The fundamental challenge is the **absence of a unified, tamper-proof digital trail** connecting procurement events to payment execution.

1.3 The Blockchain India Challenge Opportunity

The Ministry of Electronics and Information Technology (MeitY) has launched the **Blockchain India Challenge 2026** to develop permissioned blockchain solutions for digital governance [4]. The challenge explicitly identifies "e-procurement" and "supply chain management" as priority domains [5], creating an ideal context for Samādhāna.

1.4 Proposed Solution: Samādhāna

Samādhāna proposes an integrated system that:

- **Digitizes** procurement documents (Purchase Orders, Invoices, Goods Receipt Notes) on a permissioned blockchain using NBF Lite.
- **Automates** payment triggers via smart contracts upon verified acceptance of goods.
- **Executes** instant settlement using programmable Digital Rupee (e-) CBDC.
- **Creates** an immutable audit trail for compliance monitoring and financing.

The solution transforms the current reactive complaint-based model into a proactive, automated compliance system aligned with India's Digital Governance objectives.

2 Technical Foundation and Infrastructure

2.1 National Blockchain Framework (NBF)

The Government of India has established the **National Blockchain Framework (NBF)** under MeitY to enable large-scale adoption of blockchain technology for e-governance. The framework provides:

- **Blockchain-as-a-Service (BaaS)** with distributed infrastructure
- **Vishvasya** technology stack for secure application deployment
- **NBF Lite** for rapid prototyping and experimentation [6]

NBF Lite specifically supports **Hyperledger Fabric** and **Hyperledger Sawtooth** platforms for single-node setup, with smart contract templates in domains including supply chain and certificates [6]. This provides the foundation for Samādhāna’s permissioned ledger implementation.

2.2 Digital Rupee (e-) CBDC Infrastructure

The Reserve Bank of India has launched pilots for the **Digital Rupee (e-)**, India’s Central Bank Digital Currency [7]. Key features relevant to Samādhāna include:

- **Wholesale CBDC (e--W)**: For interbank settlements and high-value transactions
- **Retail CBDC (e--R)**: For public use with potential for programmability
- **Atomic Settlement**: Delivery-versus-payment capabilities
- **Programmability Features**: Under exploration for targeted use cases [7]

The programmability of CBDC is particularly crucial for Samādhāna, enabling payments to be automatically triggered upon satisfaction of predefined conditions (e.g., verified goods acceptance).

2.3 Trade Receivables Discounting System (TReDS)

The RBI-regulated **TReDS** platform enables MSMEs to discount trade receivables through competitive bidding [8]. Samādhāna can integrate with TReDS to provide verified, immutable invoice data that reduces financing costs for MSMEs.

3 System Architecture

3.1 High-Level Architecture

The Samādhāna architecture comprises four interconnected layers, as illustrated in Figure 1.

3.2 Component Design

3.2.1 Blockchain Layer (NBF Lite/Hyperledger Fabric)

- **Network Topology**: Permissioned network with nodes representing:
 - Government Procurement Departments
 - State Treasury/Finance Departments

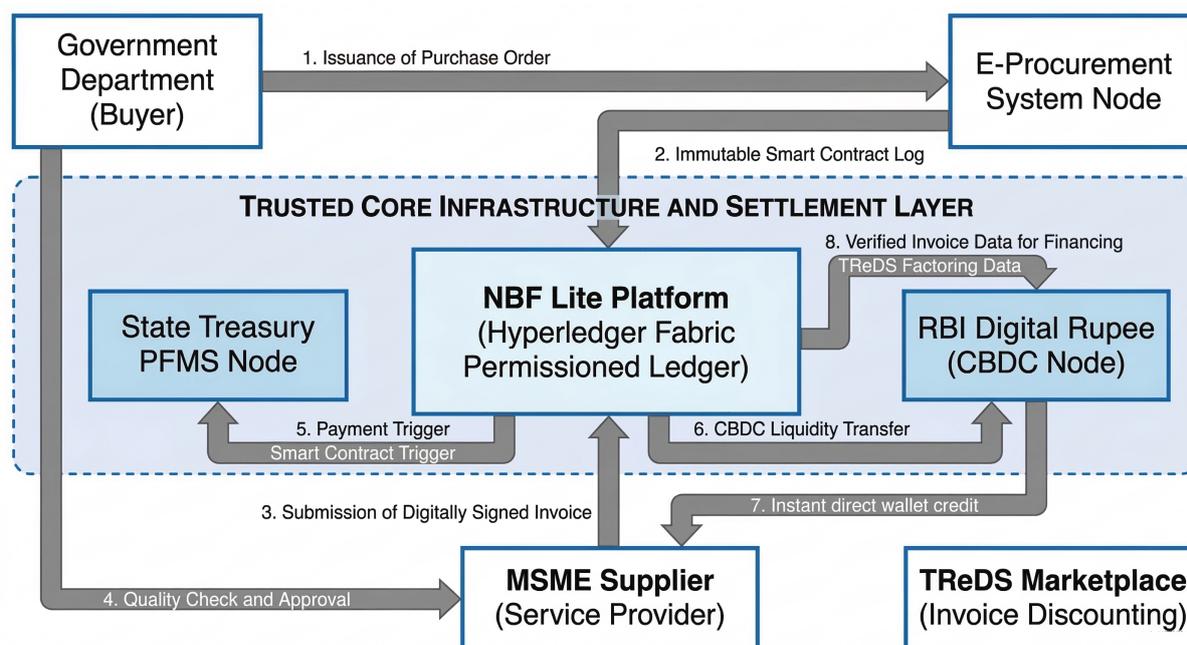


Figure 1: Layered Architecture

- Participating Banks (CBDC operators)
- MSME Suppliers (read-only nodes)

- **Smart Contract Functions:**

- `createPurchaseOrder()`: Record PO details
- `submitInvoice()`: MSME invoice submission
- `recordGoodsReceipt()`: Verify goods acceptance
- `triggerPayment()`: Initiate CBDC transfer
- `queryAuditTrail()`: Compliance monitoring

- **Data Structures:**

- Purchase Order: {PO_ID, Dept, Supplier, Amount, Date}
- Invoice: {Invoice_ID, PO_ID, Amount, Status}
- Goods Receipt: {GR_ID, Invoice_ID, AcceptanceDate, OfficerID}
- Payment: {Payment_ID, Invoice_ID, CBDC_TX_ID, Timestamp}

3.2.2 CBDC Integration Layer

- **Programmable Payment Logic:** Smart contract events trigger CBDC API calls
- **Settlement Finality:** Atomic transfer of e- upon condition satisfaction
- **Transparency:** Payment transaction hashes recorded on blockchain

3.2.3 User Interfaces

- **Government Portal:** PO creation, invoice approval, payment monitoring
- **MSME Mobile App:** Invoice submission, payment status tracking
- **Treasury Dashboard:** Real-time compliance monitoring

3.3 Transaction Flow

The typical transaction flow in Samādhāna proceeds as follows:

1. **Purchase Order Creation:** Government department creates digital PO in e-procurement system, with hash recorded on blockchain.
2. **Invoice Submission:** MSME supplier submits invoice referencing PO, with invoice data stored on ledger.
3. **Goods Receipt Verification:** Designated officer verifies goods and digitally signs acceptance, creating immutable record.
4. **Smart Contract Validation:** Chaincode validates:
 - Invoice matches PO specifications
 - Goods receipt is authenticated
 - No duplicate payment exists
5. **Payment Trigger:** Validated transaction triggers CBDC payment instruction.
6. **Settlement:** Treasury's e--W transferred to MSME's e--R wallet.
7. **Record Completion:** Payment transaction hash recorded on blockchain, completing audit trail.

4 Implementation Feasibility Analysis

4.1 Technical Feasibility

4.1.1 Proven Infrastructure Components

Table 1: Technical Feasibility Assessment

Component	Status	Source
NBF Lite (Hyperledger Fabric)	Operational	MeitY [6]
Digital Rupee CBDC Pilot	Operational (Wholesale & Retail)	RBI [7]
E-Procurement Systems	Widespread adoption	GeM, State portals
TReDS Platform	Operational (Multiple platforms)	RBI [8]

4.1.2 Integration Points

- **NBF Lite Integration:** Direct deployment of Hyperledger Fabric chaincode on government-provided infrastructure.
- **CBDC Interface:** RBI has indicated openness to programmable CBDC use cases through its pilot program [7].
- **E-Procurement APIs:** Government e-Marketplace (GeM) and state procurement portals provide integration points.

4.2 Regulatory and Policy Feasibility

- **Alignment with MSMED Act:** Solution directly enables compliance with Section 15 payment timelines.
- **Income Tax Compliance:** Creates verifiable audit trail for Section 43B(h) deduction claims.
- **Data Sovereignty:** Built on indigenous infrastructure (NBF, Digital Rupee), addressing data localization concerns.
- **Blockchain India Challenge Fit:** Meets criteria for permissioned blockchain solutions for digital governance [4].

4.3 Economic Feasibility

- **Cost Savings:** Reduced administrative overhead in payment processing.
- **Working Capital Benefits:** Faster payments reduce MSME financing needs, estimated at significant annual savings (detailed economic analysis required).
- **Infrastructure Utilization:** Leverages existing government investments in NBF and CBDC infrastructure.

5 Challenges and Mitigations

5.1 Technical Challenges

1. CBDC Programmability Maturity

- *Challenge:* Programmable CBDC features are still in pilot phase.
- *Mitigation:* Design system with fallback to conventional NEFT/RTGS for initial deployment; migrate to full CBDC as features mature.

2. Scalability

- *Challenge:* Hyperledger Fabric throughput may be challenged by high transaction volumes.
- *Mitigation:* Start with pilot departments; implement channel partitioning for scalability.

3. Identity Management

- *Challenge:* Integration with existing government identity systems.
- *Mitigation:* Leverage DigiLocker/eSign frameworks for authentication.

5.2 Operational Challenges

1. Department Adoption

- *Challenge:* Resistance to process changes in procurement departments.
- *Mitigation:* Phased implementation starting with pilot departments; demonstrate efficiency gains.

2. MSME Digital Literacy

- *Challenge:* Varying levels of digital proficiency among MSMEs.
- *Mitigation:* Simple mobile interface; training programs through MSME development institutes.

3. Change Management

- *Challenge:* Transitioning from paper-based to digital processes.
- *Mitigation:* Parallel operation during transition; clear documentation and support.

5.3 Legal and Regulatory Challenges

1. Legal Status of Blockchain Records

- *Challenge:* Uncertainty about evidentiary value of blockchain records in Indian courts.
- *Mitigation:* Coordinate with MeitY and Law Ministry for clarification; design for hybrid digital-paper trail during transition.

2. CBDC Regulatory Framework

- *Challenge:* Evolving regulations around CBDC use cases.
- *Mitigation:* Maintain close coordination with RBI pilot program; design for regulatory compliance.

6 Implementation Roadmap

6.1 Phase 1: Proof of Concept (PoC)

- **Objective:** Demonstrate technical feasibility on NBF Lite.
- **Activities:**
 - Deploy single-node Hyperledger Fabric network
 - Develop core smart contracts for procurement workflow
 - Create basic web interfaces for government and MSME users
 - Simulate CBDC payment integration using mock APIs
 - Test with sample procurement scenarios
- **Deliverables:** Working PoC demonstrating document flow and payment triggering.

6.2 Phase 2: Pilot Deployment

- **Objective:** Validate system in real government environment.
- **Activities:**
 - Partner with willing state government department
 - Integrate with existing e-procurement system
 - Connect to CBDC test environment (if available)
 - Onboard limited MSME suppliers
 - Process actual procurement transactions
- **Deliverables:** Operational pilot with 2-3 departments and 20-30 MSMEs.

6.3 Phase 3: Scaled Deployment

- **Objective:** Expand to multiple departments and states.
- **Activities:**
 - Migrate to production NBF infrastructure
 - Integrate with live CBDC systems
 - Connect with TReDS platforms
 - Develop comprehensive training programs
 - Establish 24/7 support infrastructure
- **Deliverables:** Nationwide rollout across central and state government departments.

7 Scope and Limitations

7.1 Current Scope

- **Geographic:** Domestic public procurement within India.
- **Entity Coverage:** Government departments, PSUs, and registered MSMEs.
- **Transaction Types:** Goods and services procurement.
- **Payment Mechanism:** Digital Rupee CBDC (with conventional fallback).

7.2 Explicitly Out of Scope (Current Phase)

- Cross-border trade transactions
- Private sector procurement
- Complex supply chain finance instruments
- Integration with international trade platforms

7.3 Future Extensions

- **Cross-Border Trade:** Integration with international trade finance systems using interoperable CBDC frameworks.
- **Supply Chain Finance:** Extension to multi-tier supplier networks.
- **International Standards:** Alignment with ISO 20022 and emerging trade digitization standards.

8 Conclusion

Samādhāna presents a pragmatic, technically feasible solution to one of India’s most persistent governance challenges: delayed payments to MSMEs in public procurement. By leveraging indigenous infrastructure—NBF Lite and Digital Rupee—the solution aligns perfectly with the objectives of the Blockchain India Challenge and the broader Digital India initiative.

The system transforms the current reactive, complaint-based monitoring approach into a proactive, automated compliance mechanism. Smart contracts ensure that payment timelines

mandated by the MSMED Act are automatically enforced, while the immutable audit trail facilitates both regulatory compliance and access to working capital financing for MSMEs.

While challenges exist—particularly around CBDC programmability maturity and department adoption—the phased implementation roadmap allows for iterative refinement. The potential impact on MSME working capital, government efficiency, and digital governance transformation makes Samādhāna a compelling candidate for development under the Blockchain India Challenge.

The solution represents more than a technological intervention; it is a governance innovation that demonstrates how blockchain and CBDC can be harnessed for inclusive economic growth, directly supporting India’s MSME sector and the vision of a *5trillioneconomy*.

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