L47: CBDCs and Future Trends

Module G: Regulation & Future

Blockchain & Cryptocurrency Course

December 2025

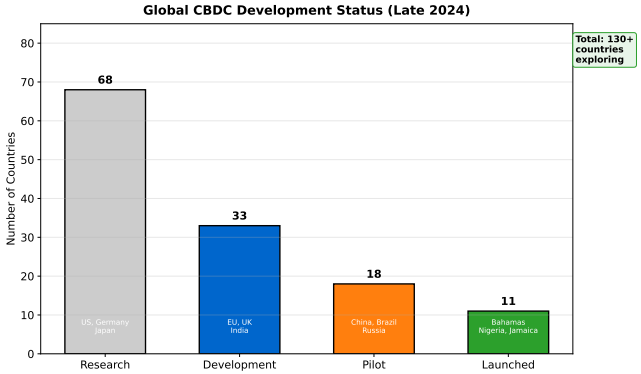
Learning Objectives

- Understand Central Bank Digital Currencies (CBDCs)
- Compare retail vs wholesale CBDC designs
- Analyze privacy vs surveillance tradeoffs
- Evaluate China e-CNY and Digital Euro progress
- Identify key future trends in blockchain technology
- Assess career opportunities in the blockchain space

What is a CBDC?

- **Definition**: Digital form of central bank money (fiat currency)
- **Not Cryptocurrency**: Centrally issued and controlled
- **Key Characteristics**:
  - Legal tender status
  - Liability of central bank (not commercial bank)
  - Electronic/digital (not physical cash)
  - May use DLT (but not required)
- **Motivation**: Respond to cash decline, private stablecoins, financial inclusion
- **Status**: 130+ countries exploring CBDCs (90% of global GDP)

Global CBDC Development Status



130+ countries exploring CBDCs, representing 90% of global GDP

Retail vs Wholesale CBDCs

Aspect	Retail CBDC	Wholesale CBDC
Users	General public	Financial institutions
Use Case	Payments, store of value	Interbank settlement
Access	Widely accessible	Restricted to banks
Technology	Various (may use DLT)	Likely DLT (efficiency)
Privacy	Balance privacy vs AML	Less concern
Examples	e-CNY, Digital Euro	mBridge, Project Jasper

Focus: Retail CBDCs have greater societal impact and complexity

Privacy vs Surveillance Tradeoff

Privacy Concerns

- Central bank sees all transactions
- Government surveillance potential
- Social credit system risks
- No cash-like anonymity

Privacy Technologies

- Zero-knowledge proofs
- Tiered privacy (small anonymous, large KYC)

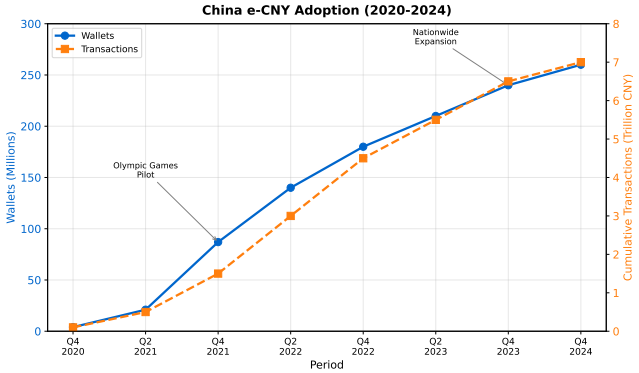
AML/CFT Requirements

- Full anonymity enables illicit finance
- Regulatory pressure (FATF)
- Tax enforcement needs

Design Spectrum

- **Full Surveillance**: China e-CNY
- **Balanced**: Digital Euro
- **Privacy-First**: Unlikely in practice

China e-CNY Adoption



Largest CBDC pilot globally, 260M+ wallets by late 2024

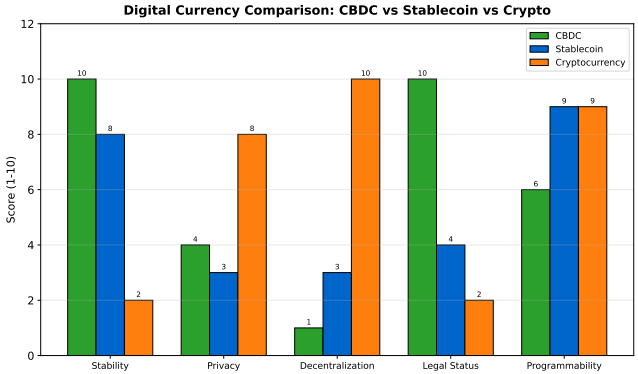
Case Study: China's e-CNY

- **Status**: Largest CBDC pilot globally (2020-present)
- **Architecture**: Two-tier (PBOC wholesale, banks retail)
- **Technology**: Centralized with distributed database
- **Features**:
  - Dual offline payment (no internet required)
  - Programmability (smart contracts)
  - "Controllable anonymity" (PBOC sees all)
- **2024 Stats**: 260M+ wallets, 7T+ yuan cumulative transactions
- **Geopolitical Angle**: Challenge USD dominance
- **Concerns**: Surveillance, limited daily usage vs Alipay/WeChat

Case Study: Digital Euro

- **Status**: Preparation phase (2024-2026)
- **Motivation**: Preserve monetary sovereignty, counter stablecoins
- **Design Principles**:
  - Privacy-focused (stronger than e-CNY)
  - Offline capability (like cash)
  - Free for basic use
  - Intermediated model (banks distribute)
- **Privacy Model**:
  - Small transactions: Cash-like privacy
  - Large transactions: Full AML compliance
- **Timeline**: Decision expected late 2025, rollout 2027-2028

Digital Currency Comparison

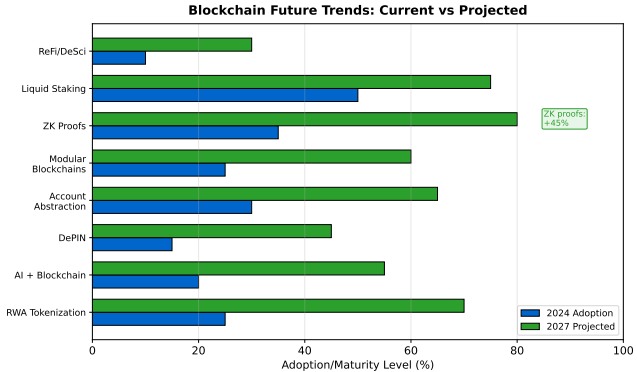


CBDCs may crowd out stablecoins but not cryptocurrencies (different use cases)

Cross-Border CBDC: mBridge

- **Project mBridge**: Multi-CBDC platform for cross-border payments
- **Participants**: China, Hong Kong, Thailand, UAE, Saudi Arabia
- **Goal**: Replace SWIFT for cross-border settlements
  - Instant settlement (vs 2-5 days)
  - Lower costs (no correspondent banking fees)
  - 24/7 operation
- **Technology**: Permissioned blockchain
- **Status**: MVP launched June 2024, live transactions completed
- **Geopolitical Implications**: Bypass USD-dominated SWIFT
- **BRICS Interest**: Alternative payment system for member nations

Future Trends: Current vs Projected

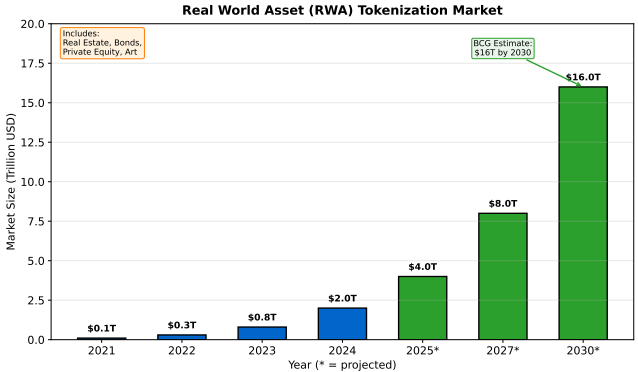


ZK proofs, liquid staking, and RWA tokenization showing strongest growth

Trend 1: Institutional Adoption Acceleration

- **2024 Status**: Crypto assets mainstream in institutional portfolios
- **Drivers**:
  - Spot Bitcoin ETFs (approved US January 2024)
  - Ethereum ETFs (July 2024)
  - Regulatory clarity (MiCA, Swiss framework)
  - Custody solutions (Coinbase Prime, Fidelity Digital Assets)
- **Institutional Products**:
  - Tokenized securities (bonds, real estate, funds)
  - Crypto lending and prime brokerage
  - Derivatives (CME futures, options)
- **Impact**: $1T+ institutional capital in crypto by 2030

RWA Tokenization Market Growth



Real world asset tokenization projected to reach $16T by 2030 (BCG estimate)

Trend 2: RWA Tokenization

- **RWA Tokenization**: Representing real assets on blockchain
- **Asset Classes**:
  - Real estate (fractional ownership)
  - Private equity and venture capital
  - Bonds (government, corporate)
  - Commodities (gold, carbon credits)
- **Advantages**:
  - Fractional ownership (lower barriers)
  - 24/7 trading (no market hours)
  - Programmable compliance
- **Leaders**: Centrifuge, Ondo Finance, Securitize, tZERO

Trend 3: AI + Blockchain Convergence

- **AI for Blockchain**:
  - Smart contract auditing
  - MEV optimization
  - DeFi risk modeling
  - On-chain analytics
- **Blockchain for AI**:
  - Decentralized AI training (Bittensor, Ocean Protocol)
  - Verifiable AI models (proof of training)
  - AI agent payments
  - Data marketplaces with access control
- **Projects**: Fetch.ai, SingularityNET, Render Network

Trend 4: Zero-Knowledge Proofs Everywhere

- **ZK Technology Maturation**: From research to production
- **Applications**:
  1. **ZK-Rollups**: Scalability (StarkNet, zkSync, Polygon zkEVM)
  2. **Privacy**: Private transactions (Aztec, Railgun)
  3. **Identity**: Prove attributes without revealing data
     - Age verification without birthdate
     - Credit score proofs without full history
  4. **Compliance**: Prove regulatory compliance privately
- **Hardware**: ZK ASICs for faster proof generation
- **Impact**: Privacy + scalability without tradeoffs

Emerging Risks and Challenges

1. **Quantum Computing Threat**:
   - ECDSA signatures vulnerable (10-20 year timeline)
   - Mitigation: Post-quantum cryptography migration
2. **Regulatory Fragmentation**:
   - Conflicting national regulations
   - Compliance complexity vs arbitrage
3. **Centralization Creep**:
   - Validator concentration (Lido 30%+ of staked ETH)
   - MEV centralization (Flashbots dominance)
4. **Systemic DeFi Risk**:
   - Composability creates cascading failures

Career Paths in Blockchain (2025+)

Technical Roles

- Smart contract developer
- Blockchain protocol engineer
- Security auditor
- ZK cryptographer

Finance/Economics

- DeFi analyst
- Tokenomics designer
- Crypto trader/quant

Legal/Compliance

- Crypto regulatory specialist
- AML/CFT compliance officer
- Web3 lawyer

Business/Product

- Web3 product manager
- DAO operations
- Community manager

Demand: 50,000+ open blockchain jobs, growing 30%+ annually

Summary

Key Takeaways:

- **CBDCs**: 130+ countries exploring, retail vs wholesale designs
- **Privacy vs surveillance**: Key CBDC design tradeoff
- **e-CNY (2024)**: 260M+ wallets, expanded nationwide
- **Digital Euro**: Preparation phase, decision late 2025
- **mBridge**: Cross-border CBDC platform, MVP launched 2024
- **RWA tokenization**: Projected $16T by 2030
- **ZK proofs**: Privacy + scalability convergence
- **AI + Blockchain**: Emerging synergies
- **Career opportunities**: 50,000+ jobs across tech, finance, legal

Questions for Reflection

1. What are the key differences between retail and wholesale CBDCs?
2. How should CBDCs balance privacy and AML compliance?
3. Why might e-CNY adoption remain limited despite government push?
4. Which future trend (RWA, ZK, AI+Blockchain) has most potential?
5. How might mBridge affect the global financial system?