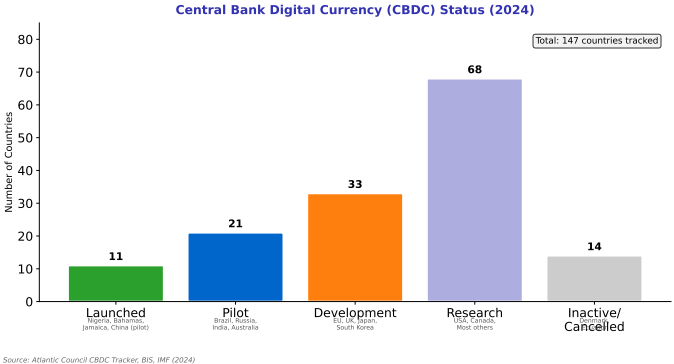
Lesson 48: CBDC and Future

Mini-Lecture Version (30 min)

Digital Finance

Learning Objectives: Understand Central Bank Digital Currency (CBDC) design principles and architectures — Analyze Digital Euro project and global CBDC landscape — Examine retail vs wholesale CBDC models — Evaluate programmable money and smart contract integration

Global CBDC Adoption Status



This concept is fundamental to understanding CBDC and Future.

What is a CBDC?

Definition:
Central Bank Digital Currency (CBDC) is a digital form of central bank money, distinct from balances in traditional reserve or settlement accounts.

Key Characteristics:

- **Central Bank Liability:** Direct claim on central bank (like cash)
- **Digital:** Electronic, not physical currency
- **Legal Tender:** Government-backed, accepted for payments
- **Programmable:** Potential for conditional payments
- **Account-Based or Token-Based:** Identity vs bearer instrument

CBDC vs Other Digital Money:

- **Commercial Bank Deposits:** Bank liability, deposit insurance
- **Cryptocurrencies:** Decentralized, volatile, no legal tender status
- **Stablecoins:** Private issuers (Tether, USDC), reserves backing

Motivation for CBDCs:
Policy Goals:

- **Payment Efficiency:** Faster, cheaper cross-border payments
- **Financial Inclusion:** Access for unbanked populations
- **Monetary Sovereignty:** Counter private stablecoins (Libra/Diem threat)
- **Cash Decline:** Digital alternative as physical cash usage drops
- **Innovation Platform:** Programmable money, smart contracts

Risks and Concerns:

- **Bank Disintermediation:** Flight to CBDC during crises
- **Privacy:** Central bank surveillance potential
- **Cybersecurity:** Attractive target for attacks
- **Cross-Border Capital Flows:** Bypass capital controls
- **Operational Complexity:** 24/7 availability, scalability

Understanding this definition is foundational for CBDC and Future.

Retail vs Wholesale CBDCs

Retail CBDC (General Purpose):
Users:

- Households and businesses
- Direct access to central bank money
- Digital cash alternative

Use Cases:

- Everyday payments (groceries, bills)
- P2P transfers
- E-commerce
- Government disbursements (stimulus, benefits)

Design Considerations:

- Distribution model (direct vs two-tier)
- Anonymity vs AML compliance
- Interest-bearing vs non-interest
- Holding limits (caps to prevent bank runs)
- (See full lecture for details)

Wholesale CBDC (Limited Access):
Users:

- Banks and financial institutions
- Authorized payment service providers
- No public access

Use Cases:

- Interbank settlements (RTGS enhancement)
- Securities settlement (DVP)
- Cross-border payments (FX vs payment)
- Central bank operations (repo, monetary policy)

Advantages:

- Less disruptive to banking system
- Lower technology scaling requirements
- Easier privacy/AML balance
- Building block for retail later

Most advanced projects: Wholesale (e.g., Project Jura, Aber) vs retail still exploratory (Digital Euro, e-CNY pilot)

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Digital Euro: Design and Timeline

ECB Digital Euro Timeline:
2020-2021: Investigation Phase

- Report on digital euro (October 2020)
- Public consultation (8000+ responses)
- Decision to launch investigation (July 2021)

2021-2023: Investigation

- 24-month investigation phase
- Design choices and technology exploration
- Prototypes and proof-of-concepts
- Rulebook drafting

2023-2025: Preparation Phase (Current)

- Scheme development (rules, standards)
- Technology provider selection
- Legislative framework (EU Digital Euro Regulation)

2025-2027: Implementation (Planned)

- Platform development and testing
- Pilot programs
- Potential launch decision

Key Design Choices (ECB Announcements):
1. Two-Tier Distribution:

- ECB issues, supervised intermediaries distribute
- Banks and PSPs provide wallets and services
- No direct ECB customer relationship

2. Privacy-Preserving:

- Offline payments: Full anonymity (like cash)
- Online payments: Privacy from merchants, AML compliance
- ECB does not track individual transactions

3. Holding Limits:

- Caps on digital euro holdings (proposed EUR 3,000-4,000)
- Prevent bank disintermediation
- Higher amounts: tiered remuneration (negative interest)

4. Offline Capability:

- Works without internet (NFC, Bluetooth)
- Resilience during outages
- Privacy benefit (no central server involved)

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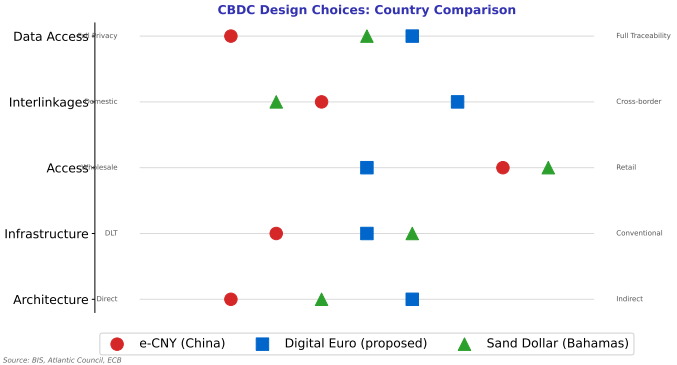
CBDC Design Choices



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Swiss CBDC: Project Helvetia

Project Helvetia Overview:

- SNB + BIS + SIX collaboration
- Wholesale CBDC pilot (not retail)
- Launched December 2023
- Runs until at least June 2027

Key Milestones:

- Phase I (2020): Proof of concept
- Phase II (2022): Integration tests
- Phase III (2023-): Live pilot

2024 Achievements:

- CHF 750M+ in digital bonds settled
- CHF 64M SNB bills issued (June 2024)
- World's first monetary policy op on DLT
- 6 major banks participating

Participants:

UBS, Zuercher KB, Basler KB, BCV, Commerzbank, Hypo Lenzburg

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Swiss Position on Retail CBDC

SNB Retail CBDC Position:

- Currently: No retail CBDC planned
- Swiss payment system "works well"
- TWINT mobile payments widespread
- No urgent need identified

Concerns Raised:

- Bank disintermediation risk
- Financial stability concerns
- Privacy considerations
- Implementation complexity

Focus on Wholesale CBDC:

- Institutional settlement focus
- Integration with existing FMI
- Lower disruption risk
- Clear efficiency gains

Key Quote (SNB):

"With the ongoing improvement of the payment system, the SNB currently sees no need for digital central bank money for the general public."

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Digital Euro Technology Architecture

Technical Approach:
Centralized Ledger vs DLT:

- ECB leaning toward centralized database
- DLT explored but performance concerns
- Hybrid possible: Central ledger + DLT for settlement

Core Components:

1. Central ledger of all digital euro balances
2. Final settlement authority
3. Reconciliation and oversight
4. Customer onboarding (KYC/AML)
5. (See full lecture for details)

Offline Payment Technology:
Hardware Wallets:

- Secure element (e.g., SIM card, smart card)
- Store digital euro locally (encrypted)
- NFC for proximity payments (contactless)
- Bluetooth for device-to-device transfers

Offline Protocol:

- Cryptographic signatures verify authenticity
- Double-spending prevention (local nonce tracking)
- Periodic online synchronization
- Limits on offline value (EUR 100-500)

Privacy Architecture:

- Blind signatures or zero-knowledge proofs
- Pseudonymous identifiers (rotate frequently)
- ECB sees aggregates, not individual transactions
- Intermediaries handle AML checks

Key challenge: Balance privacy (citizen demand) with AML compliance (regulatory requirement)

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Key Takeaways

1. Understand Central Bank Digital Currency (CBDC) design principles and architectures
2. Analyze Digital Euro project and global CBDC landscape
3. Examine retail vs wholesale CBDC models
4. Evaluate programmable money and smart contract integration

Bottom Line: CBDC and Future is transforming how financial services operate and compete.

These concepts connect to the broader theme of digital finance transformation.

CBDC and Future in Visual Perspective

Technology view

Application view

Future view

Visual representations help reinforce key concepts of cbdc and future.

Concrete Examples: Making It Real

Technical Examples

- Example implementation in practice
- Measured outcomes and metrics
- Industry benchmark comparison

Case Study

- Real-world deployment scenario
- Quantifiable results achieved

Industry Leaders

- Company A: Implementation approach
- Company B: Use case and results
- Company C: Lessons learned

Market Data

- Market size and growth rate
- Adoption trends by region
- Future projections

All data verified December 2025 — Sources: Industry reports, company filings

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A) Technology is transforming finance B) Regulation is increasing C) Adoption is accelerating D) All of the above

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Q10. What is a key takeaway about cbdc and future?
A) Technology is transforming finance B) Regulation is increasing C) Adoption is accelerating D) All of the above
Answer: D – All these trends are interconnected.