

Lesson 1: What is Blockchain?

History, Motivation & Core Concepts

BSc Blockchain, Crypto Economy & NFTs

FHGR School of Management

Winter Semester 2025

By the end of this lesson, you will be able to:

1. Define blockchain and identify its core components
2. Trace the historical evolution from 1991 to present day
3. Understand the double spending problem and how blockchain solves it
4. Identify real-world applications across industries

Duration: 45 minutes

This lesson establishes the foundation for understanding distributed ledger technology

Part 1: Foundation (20 min)

- Historical timeline 1991-2025
- The double spending problem
- Why previous digital cash failed

Part 2: Core Concepts (25 min)

- Block structure and chain linking
- Distributed ledger architecture
- Immutability and decentralization
- Real-world applications

Format: Interactive lecture with visual demonstrations

Questions welcome throughout the session

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Chart: Timeline visualization 1991-2008

1991: Cryptographic Foundations

- Haber & Stornetta: timestamping
- First blockchain-like structure
- Published in *Journal of Cryptology*
Foundation concepts existed decades before Bitcoin

2004: Reusable Proof-of-Work

- Hal Finney introduces RPOW
- Attempt at digital scarcity
- Required trusted servers

Historical Timeline: The Bitcoin Revolution

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Chart: Timeline visualization 2008-2015

October 31, 2008

Satoshi whitepaper:

"Bitcoin: A Peer-to-Peer Electronic
Cash System"

~~Bitcoin solved the double spending problem without trusted third parties~~

January 3, 2009

Genesis block mined

Network goes live

~~Block reward: 50 BTC~~

July 30, 2015

Ethereum launches

Smart contracts enabled

Blockchain 2.0 era begins

[5.5cm]

Chart: Timeline visualization 2020-2025 with major milestones

2020-2024: Corporate Entry

- PayPal adds crypto support (2020)
- Tesla invests \$1.5B in Bitcoin (2021)
- El Salvador adopts Bitcoin as legal tender (2021)

2024-2025: Mainstream Integration

- Bitcoin ETF approvals (Jan 2024)
- Institutional custody solutions
- Central bank digital currencies (CBDCs)

The Problem: Double Spending

Physical Cash: No Problem

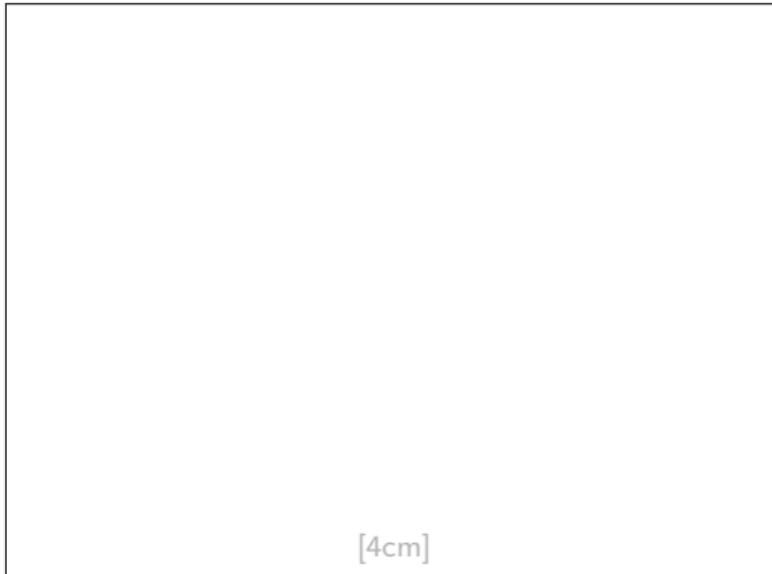


Chart: Physical money exchange diagram

- Alice gives \$10 bill to Bob
- Alice no longer has the bill
- ~~Physical scarcity prevents duplication~~
~~Double spending was the fundamental barrier to digital currency~~

Digital Cash: Major Problem

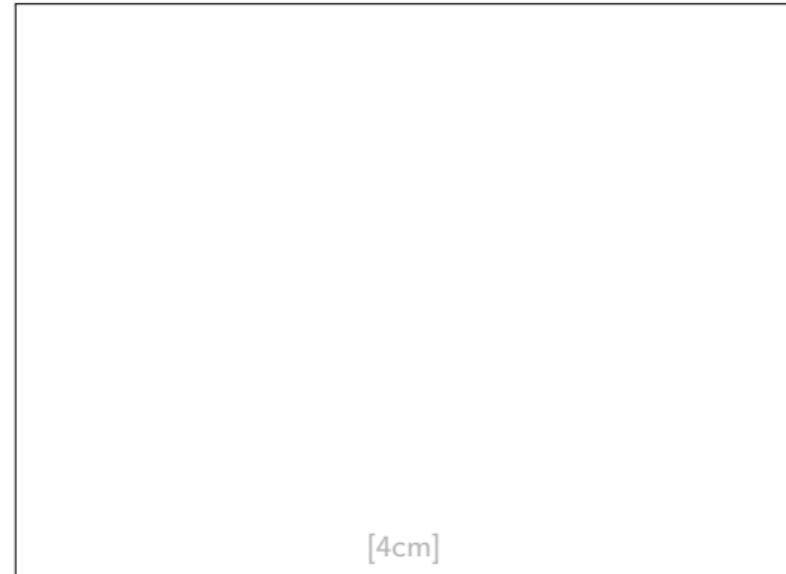
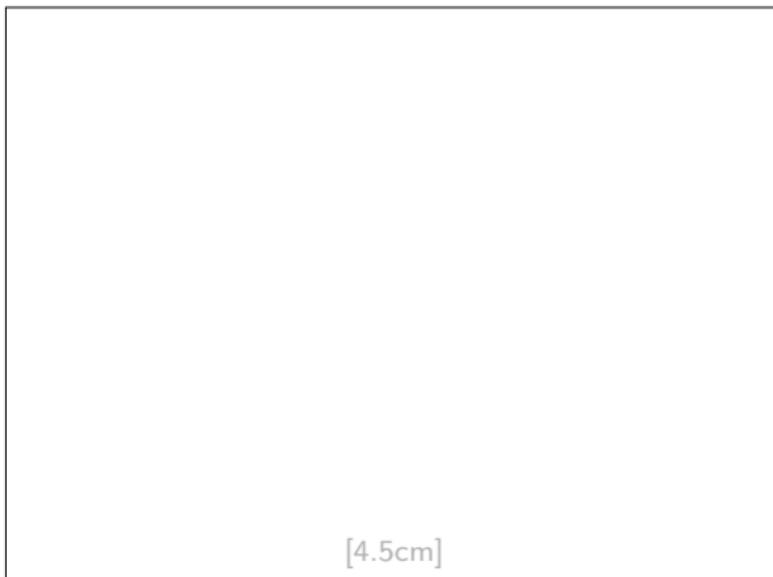


Chart: Digital file duplication diagram

- Digital files are easily copied
- Alice could send same \$10 to Bob and Carol
- No inherent scarcity in digital format

Traditional Solution vs. Blockchain Solution

Centralized Solution (Banks)

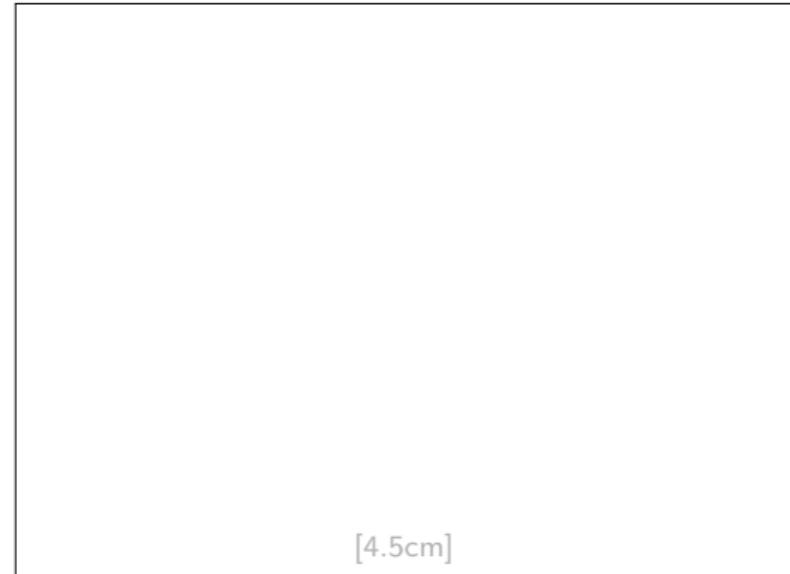


[4.5cm]

Chart: Centralized ledger with bank as middleman

- + Prevents double spending
- + Familiar and trusted
- Single point of failure

Blockchain Solution



[4.5cm]

Chart: Distributed ledger with multiple nodes

- + Prevents double spending
- + No intermediary needed
- + 24/7 global access

[5cm]

Chart: Detailed block anatomy showing header and body

Block Header

- Previous block hash (link to chain)
- Timestamp
- Nonce (for proof-of-work)

Block Body

- List of verified transactions
- Bitcoin: avg 2,000-3,000 transactions
- Block size: 1-4 MB (Bitcoin)

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Chart: Chain of blocks showing hash connections

How Blocks Link Together:

- Each block contains the hash of the previous block
- Hash functions create unique digital fingerprints
- Changing any data changes the hash
- Broken hash link = invalid chain

[5cm]

Chart: Network diagram showing multiple nodes with identical ledgers

Key Characteristics

- Thousands of identical copies
- Bitcoin: 15,000+ full nodes
- Each node validates independently

Benefits

- No single point of failure
- High availability (99.99%+)
- Transparent and auditable

Why Changes are Impossible

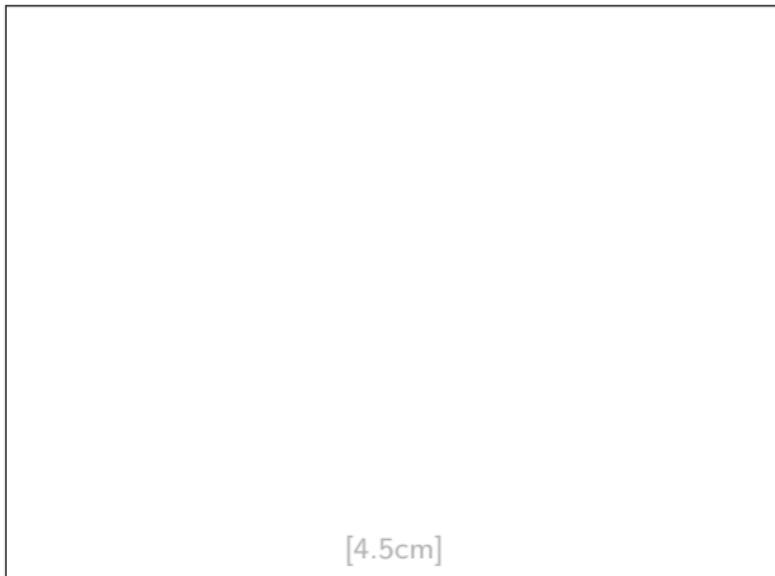


Chart: Cascade effect of changing one block

1. Attacker changes Block 100
2. Hash of Block 100 changes
3. Block 101 now points to wrong hash

Mathematical Security

- Bitcoin network: 400+ EH/s
- Would need 51% of computing power
- Cost: billions of dollars in hardware
- Economically irrational for attacker
- Deeper blocks = more secure

Best Practice: Wait 6 confirmations (60 min) for large transactions

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Chart: Centralized vs Decentralized vs Distributed network topology

Centralized

- Single authority
 - Fast decisions
 - ~~Single point of failure~~
- ~~True blockchain systems are distributed, not just decentralized~~

Decentralized

- Multiple authorities
- Federated control
- Resilient to attacks

Distributed (Blockchain)

- No authorities
- Peer-to-peer consensus
- Maximum resilience

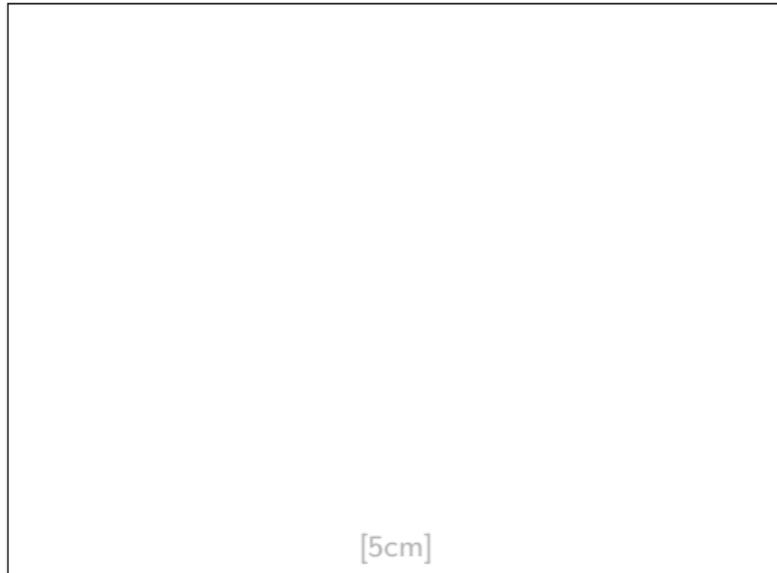


Chart: Market statistics visualization

From zero to mainstream adoption in 15 years

Market Size (2024-2025)

- Bitcoin market cap: \$1.79 trillion
- Total crypto market cap: \$3+ trillion
- Daily trading volume: \$100+ billion

User Adoption

- Global crypto users: 559-617 million
- 28% of US adults own cryptocurrency
- Growth rate: 34% year-over-year

Network Activity

- Bitcoin transactions: 300,000-400,000/day
- Ethereum transactions: 1.2 million/day
- Combined: 2,000+ blockchain networks

Financial Services

- Cross-border payments (Ripple, Stellar)
- Decentralized finance (Uniswap, Aave)
- Tokenized assets (real estate, stocks)
- Stablecoins (USDC, USDT)

Supply Chain

- Walmart: food traceability
- Maersk: shipping logistics
- De Beers: diamond provenance
- Pharmaceutical authentication

Digital Identity

- Self-sovereign identity (SSI)
- Credential verification
- Healthcare records
- Academic diplomas

Government & Public Sector

- Land registries (Georgia, Sweden)
- Voting systems (pilot projects)
- Public benefit distribution
- Tax collection and auditing

Blockchain is transitioning from cryptocurrency to enterprise infrastructure

[5cm]

Chart: Job market and salary data visualization

Technical Roles

- Blockchain developer: \$100k-\$180k
- Smart contract auditor: \$120k-\$200k
- Protocol engineer: \$150k-\$250k

Business Roles

- Blockchain consultant: \$90k-\$150k
- Product manager: \$110k-\$180k
- Legal and compliance specialist

Summary: Key Takeaways

What We Learned

1. Blockchain evolved from 1991 research to \$3T market
2. Solves double spending without intermediaries
3. Core components: blocks, chain, distribution, immutability
4. Applications span finance, supply chain, identity

Preparation: Review Satoshi Nakamoto whitepaper (provided in course materials)

Next Lesson Preview

- L02: Distributed Ledger Technology Deep Dive
- Consensus mechanisms
- Byzantine Fault Tolerance
- Network architecture

Questions? Office hours: Thursdays 14:00-16:00

Thank you

Questions?

Next: Lesson 2 – Distributed Ledger Technology