RSAConference2018
San Francisco | April 16 – 20 | Moscone Center

SESSION ID: SEM-M02

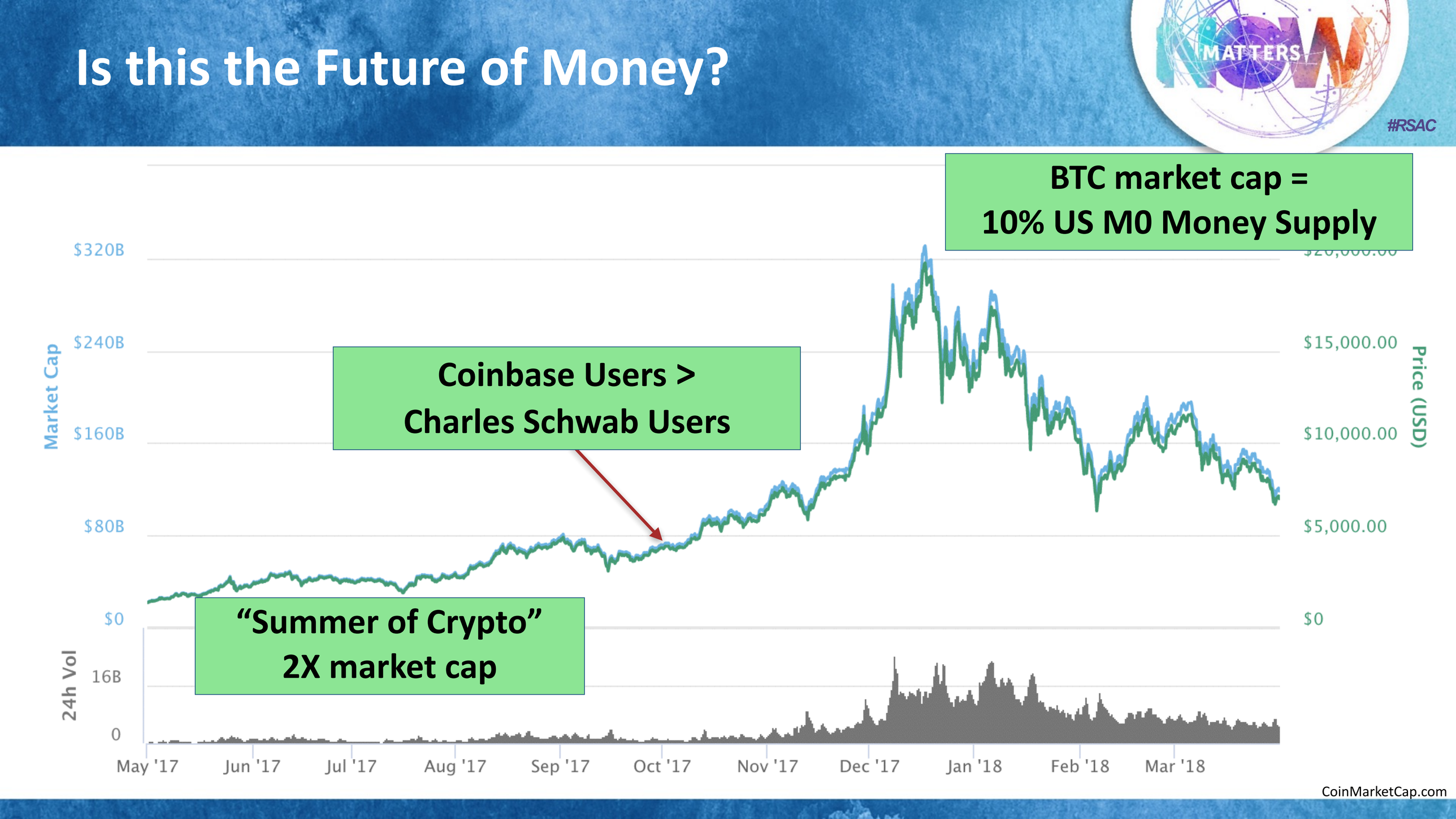
FOUNDATIONS OF BITCOIN, BLOCKCHAIN, AND SMART CONTRACTS

What You Need to Know About Bitcoin & Crypto

Benjamin Jun, HVF Labs

HVF

Is this the Future of Money?



CoinMarketCap.com

Today's Agenda

1/ FUNDAMENTALS

- Bitcoin, Blockchain, and Smart Contracts
- Ethereum, Tokens, and ICOs

2/ APPLICATIONS

- Blockchain for the Enterprise
- Case: Identity and Federations
- Legal – Smart Contracts, Blockchain, and ICOs

3/ ATTACKS

- Cryptocurrency Attacks and Security Challenges
- Bad Actors in ICOs, Ransomware

Satoshi's World

Bitcoin: A Peer-to-Peer Electronic Cash System (2008)

Satoshi Nakamoto
satoshin@gmx.com
www.bitcoin.org

Abstract. A purely peer-to-peer version of electronic cash would allow online payments to be sent directly from one party to another without going through a financial institution. Digital signatures provide part of the solution, but the main benefits are lost if a trusted third party is still required to prevent double-spending. We propose a solution to the double-spending problem using a peer-to-peer network. The network timestamps transactions by hashing them into an ongoing chain of hash-based proof-of-work, forming a record that cannot be changed without redoing the proof-of-work. The longest chain not only serves as proof of the sequence of events witnessed, but proof that it came from the largest pool of CPU power. As long as a majority of CPU power is controlled by nodes that are not cooperating to attack the network, they'll generate the longest chain and outpace attackers. The network itself requires minimal structure. Messages are broadcast on a best effort basis, and nodes can leave and rejoin the network at will, accepting the longest proof-of-work chain as proof of what happened while they were gone.

1. Introduction

Peer-to-Peer

Digital Signatures

No Trusted Third Party

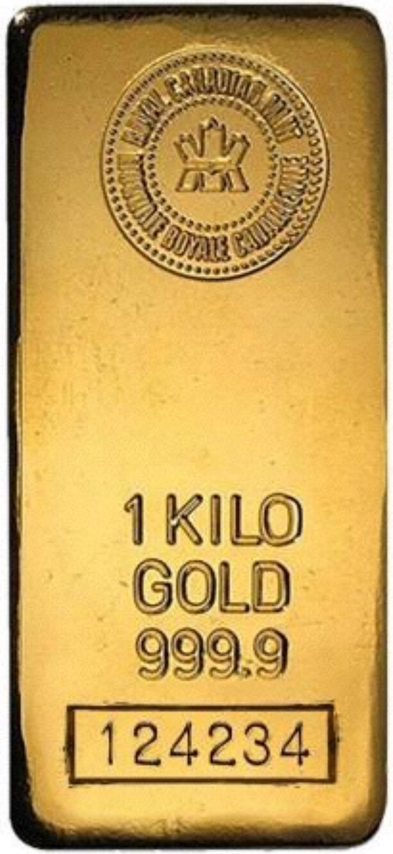
Decentralized

Chained Proof-of Work

Value

bitcoin

Units of Value

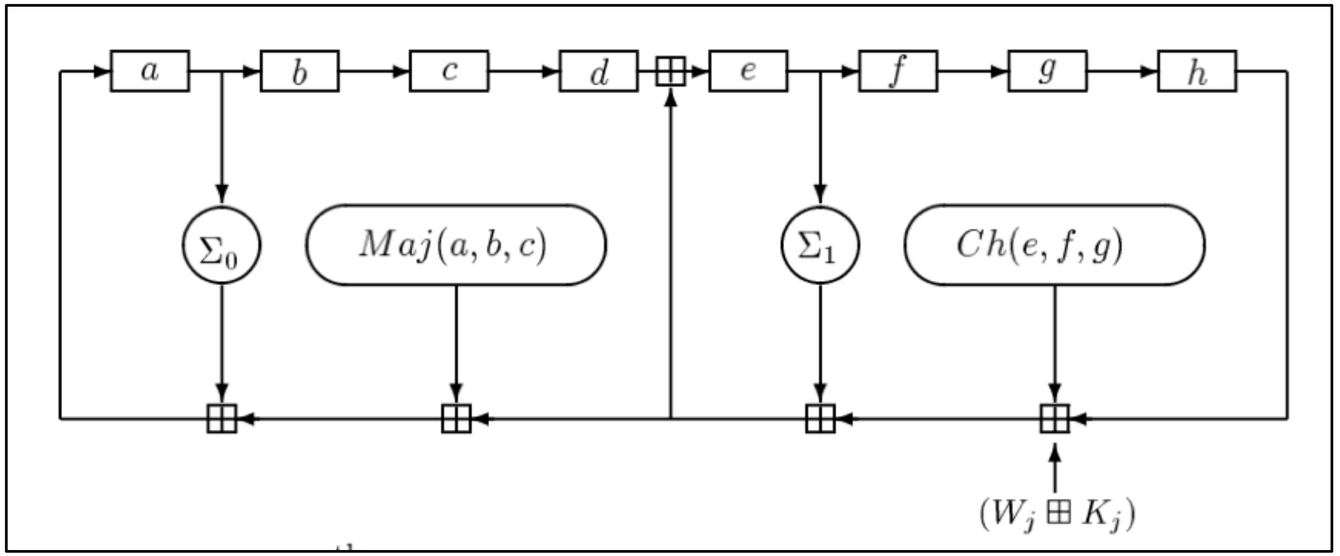


Token value based on supply & demand

Mining For Value

Bitcoin: “Proof-of-Work” Mining

SHA-256 Hash Function (adopted 2002)



1. Repeat SHA-256 until result = “rare”

2. Credit the finder

Hashes

Hash 00000000000000000023279ea4059b36d44a354b1d283560cdb0860c508f620d

Modern Mining Tools

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Contracts

Signed Transfers

Alice's Car
Transfer to Bob

Alice Signs

Bob's Car
Transfer to Cheryl

Bob Signs

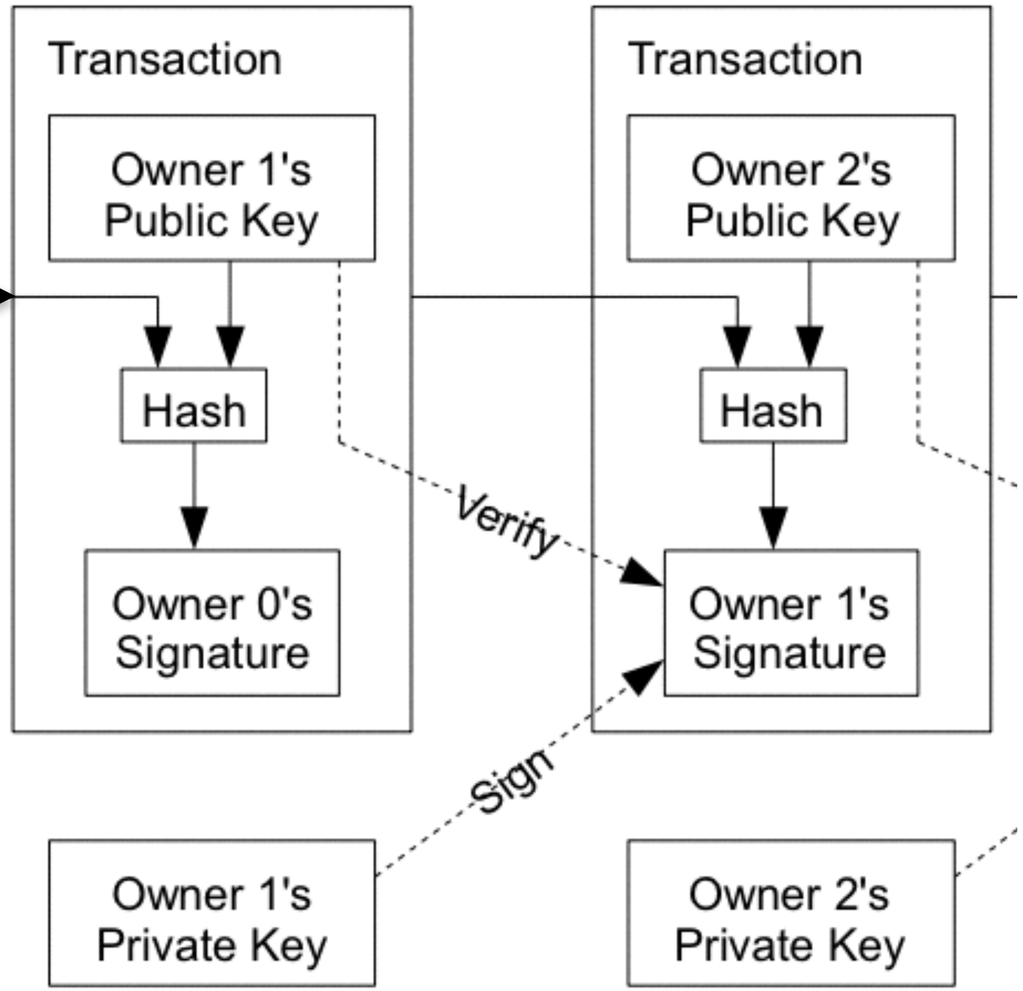
Digital Signatures

Alice —> Bob

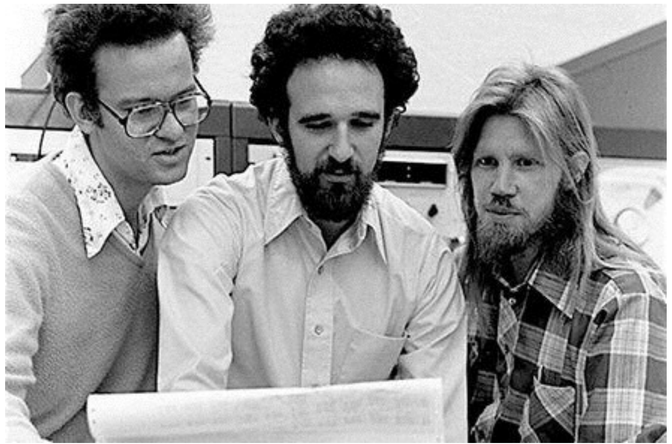
Bob —> Cheryl

Cheryl —> Dan

Dan —> Eve



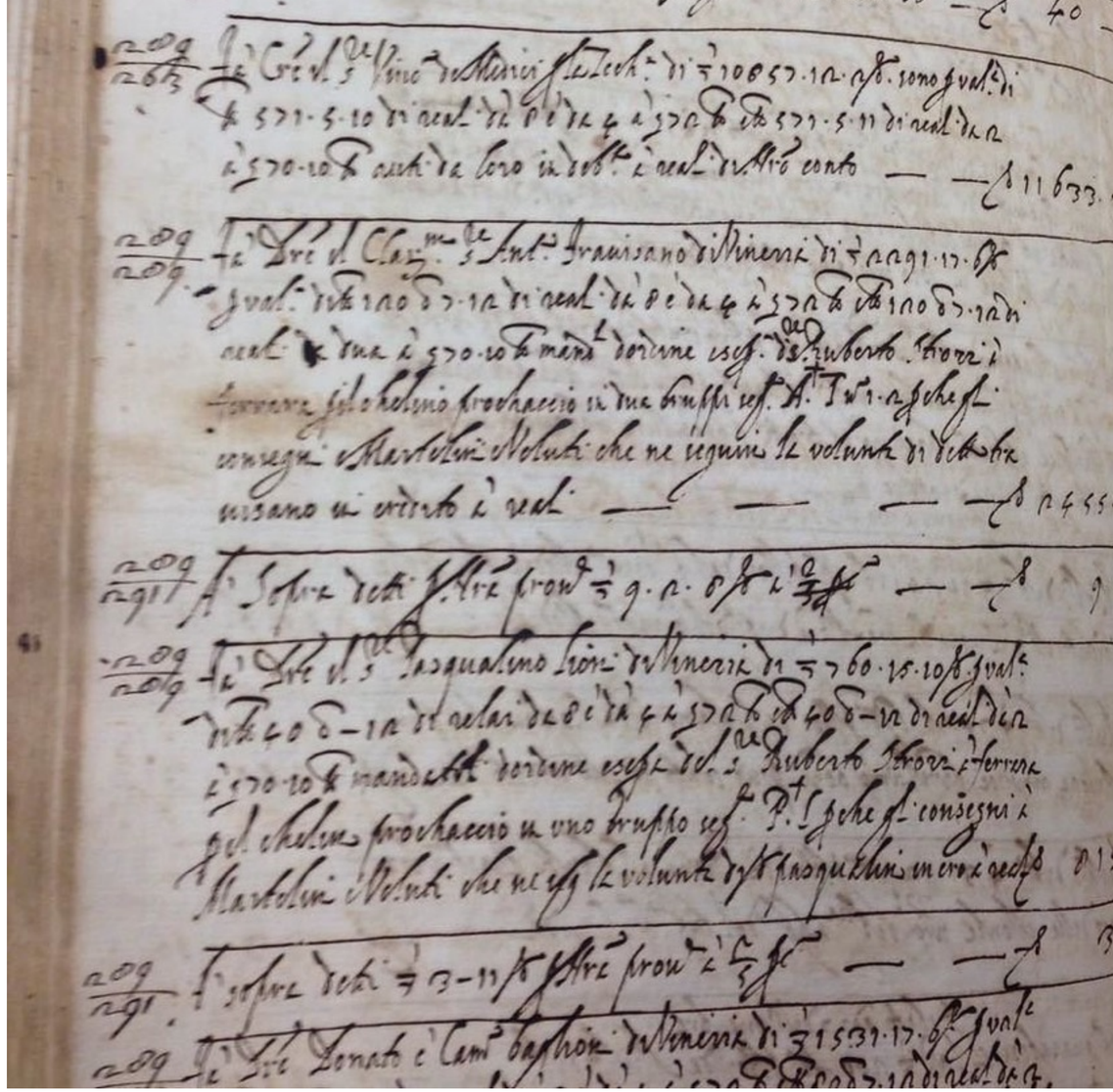
Merkle - Diffie - Hellman



Ledgers

bitcoin

Luca Pacioli ~1500

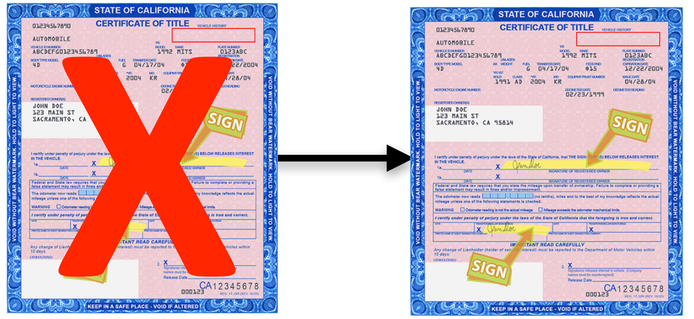


Medici Family

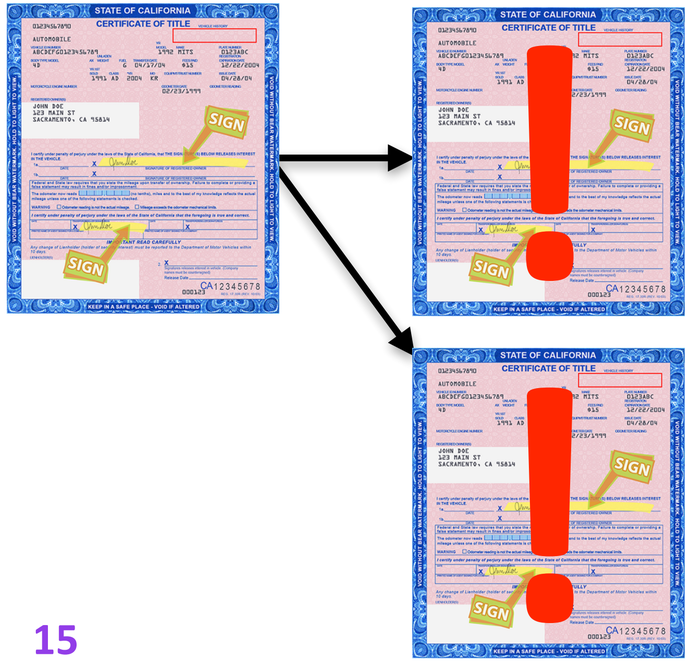
Debtors & Creditors (1605-1633)

UPenn ms. codex 1312 91r

When Contracts Aren’t Centralized…



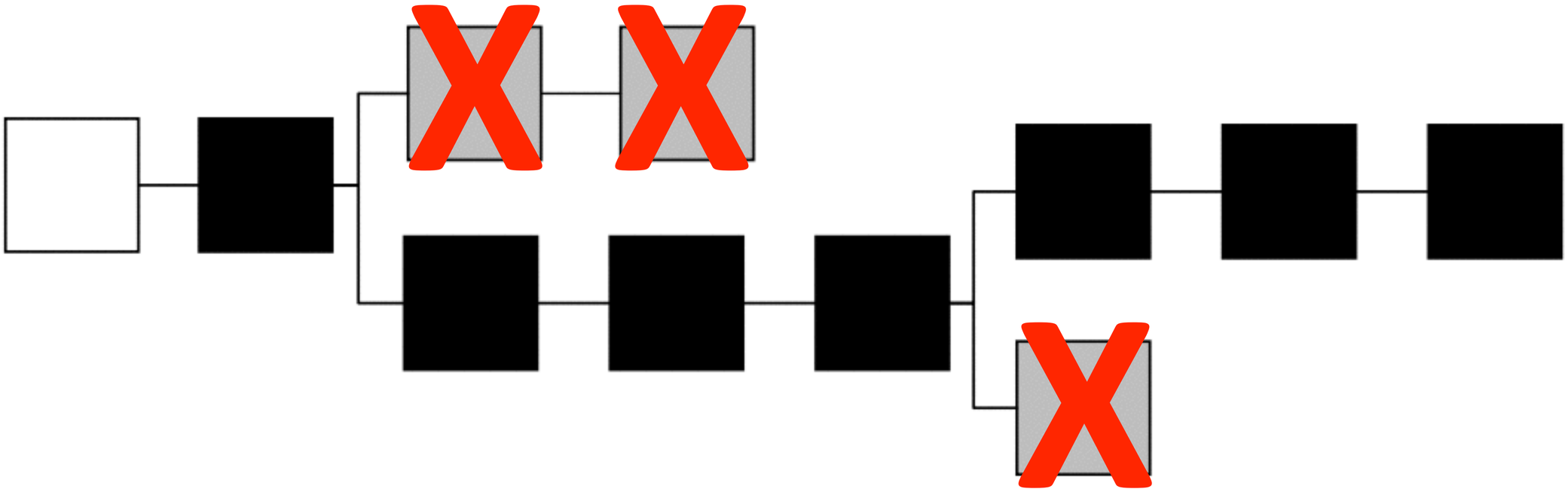
FORGED DATA

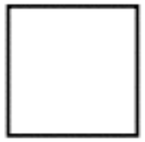


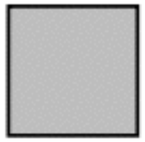
DOUBLE SPEND

Public Ledger

Satoshi's Blockchain



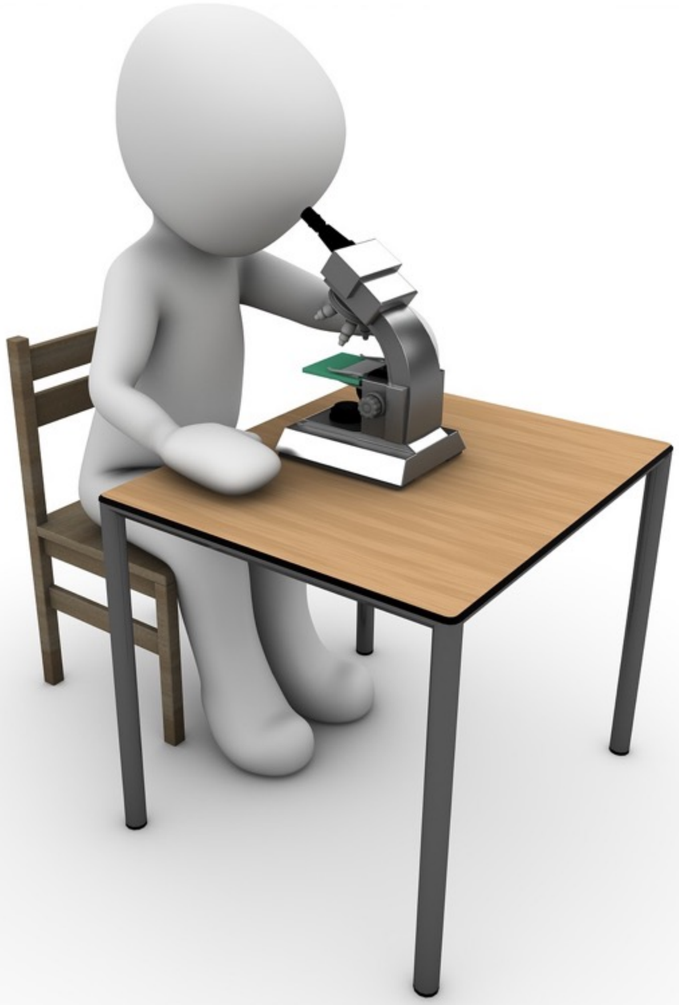

Genesis Block


Orphaned blocks


Main blocks

Order From Crowds

A Closer Look



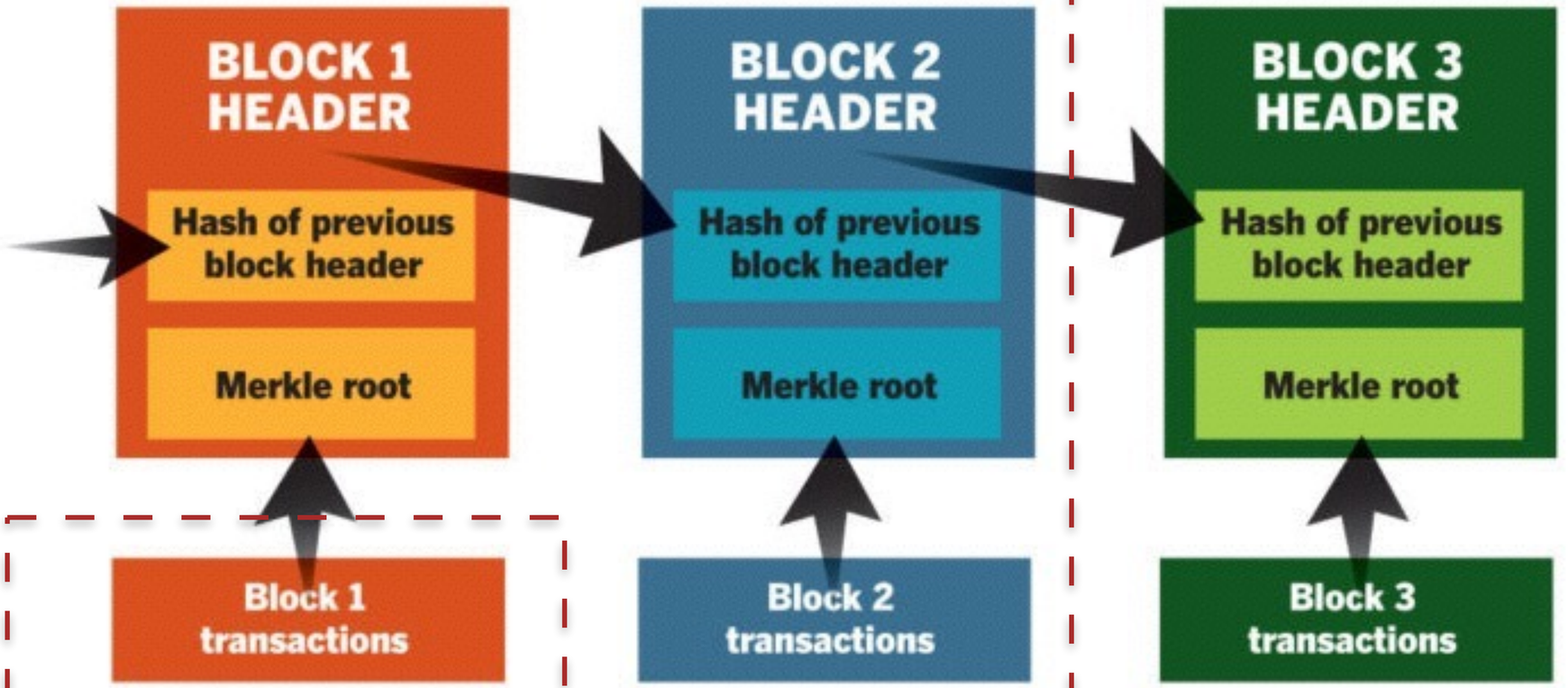
Bitcoin Statistics (April 2018)

Supply = ~17M bitcoins (BTC)

Demand = exchange rate: $8000 USD per BTC

- **$137B** in circulation (3.6% of US M0 money supply)
- Daily on-chain transactions: **$5B (3.5%)**
- Daily mining: **144 “winners”, 1800 BTC, $14.4M**

Bitcoin Blockchain (Ledger!)



1500-2000 transactions

New block every ~10 min

Size: 164GB
(April 2018)

www.cio.com

Block #132749: Header Data

Block Depth & Time

Height	132749 (Main Chain)
Timestamp	2011-06-23 06:50:15

Hashes

Lots of leading zeros…

Hashes	
Hash	00000000000004bea72d0f390194b08162665a4fc99469c576338cd37164a15a
Previous Block	00000000000001d7de3a0e9fb1ea091780bcfef5ce4967efd86d536859f9e6b8a

Block #132749: Transactions

Transactions

f2ee93039126a28bd352e708bd67c2edaa10f0f2e18a9a1305129468fdf22b37 — **2011-06-23 06:50:15**

No Inputs (Newly Generated Coins)	→ 1KWFWpC4tmKQuhraK6XyAFz9ypKqFva4RH	50.10132691 BTC

Mining "winner" gets 50 BTC

50.10132691 BTC

3a1b9e330d32fef1ee42f8e86420d2be978bbe0dc5862f17da9027cf9e11f8c4 — **2011-06-23 06:50:15**

17dxcM1cdeXPL1rZNJDAFwU2C4H9Xf5VqR 19H4PcfyPCw8FUh5J1pma5Bb9w2srhYcQ4 1LfddcwiNnJ7Hk3KpBv5AfcTMD1fCahLqY 15oGga9EJ7BzdZxFnEcDxQDZvh1dHZ6Zco 1FfsbQntU2BAkVy2xaaRpSmLEDMEUwPbG1 1MtyGxTeWmjNhXyBf85JPKL5vrhTRJ7HnD 14yX4kRDME61BbM7DMnuv1PKUtk8K65J4y 191sZm1o7WZ1baNqUmRow6RPo293gbeJLW 1Q4EpJ6eaXDV1mEHx7JgupBuGNi4GBcMbV	→ 1Hzpk4eXTbrAfmH2noWrkrgxo6ewH6qncd 1eHhgW6vquBYhwMPhQ668HPjxTtpvZGPC	17,757.57575758 BTC 424,242.42424242 BTC

Transfer of 424 BTC

442,000 BTC

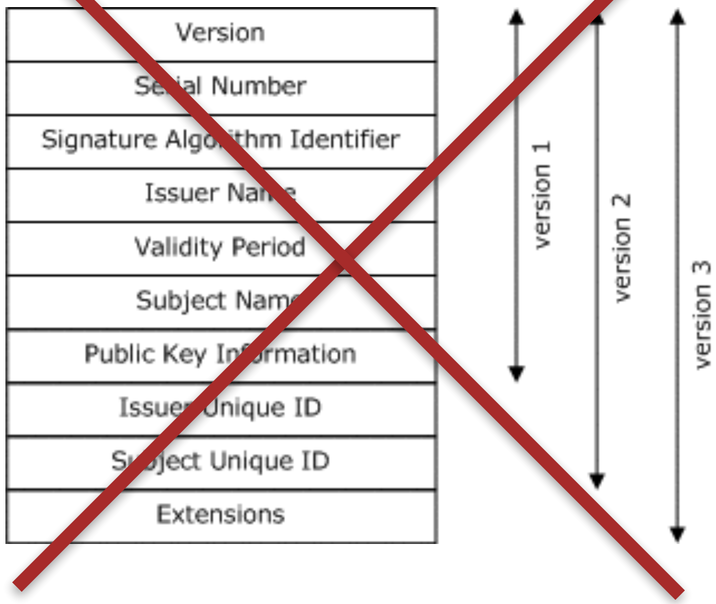
Identity (“Wallet”) Management

Bitcoin Address

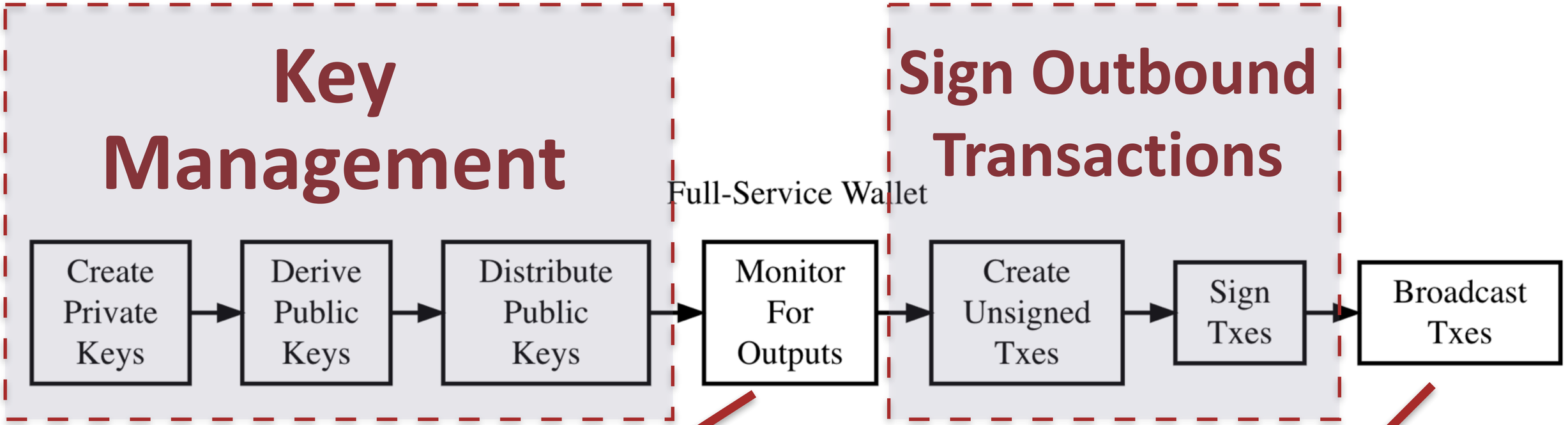
Summary	
Address	1eHhgW6vquBYhwMPhQ668HPjxTtpvZGPC
Hash 160	070d550bc5bc843149410b8863b5b72857d91439

Transactions	
No. Transactions	48
Total Received	474,320.43446353 BTC
Final Balance	0.00011111 BTC

NOT X.509



Wallet Operations



Monitor Blockchain For Incoming BTC

Place Outbound Transactions to Blockchain

Decentralized, Trustless, Transparent

Bitcoin is coordinated under policies set in motion by Satoshi in 2008. It has no central administrator and no governing body*.

**** These folks may want to talk to you:***

- *Securities and Exchange Commission*
- *Commodity Futures Trading Commission*
- *Internal Revenue Service*
- *US States*
- *Department of Treasury*

Post-Satoshi World

“Trust” and Enforcement

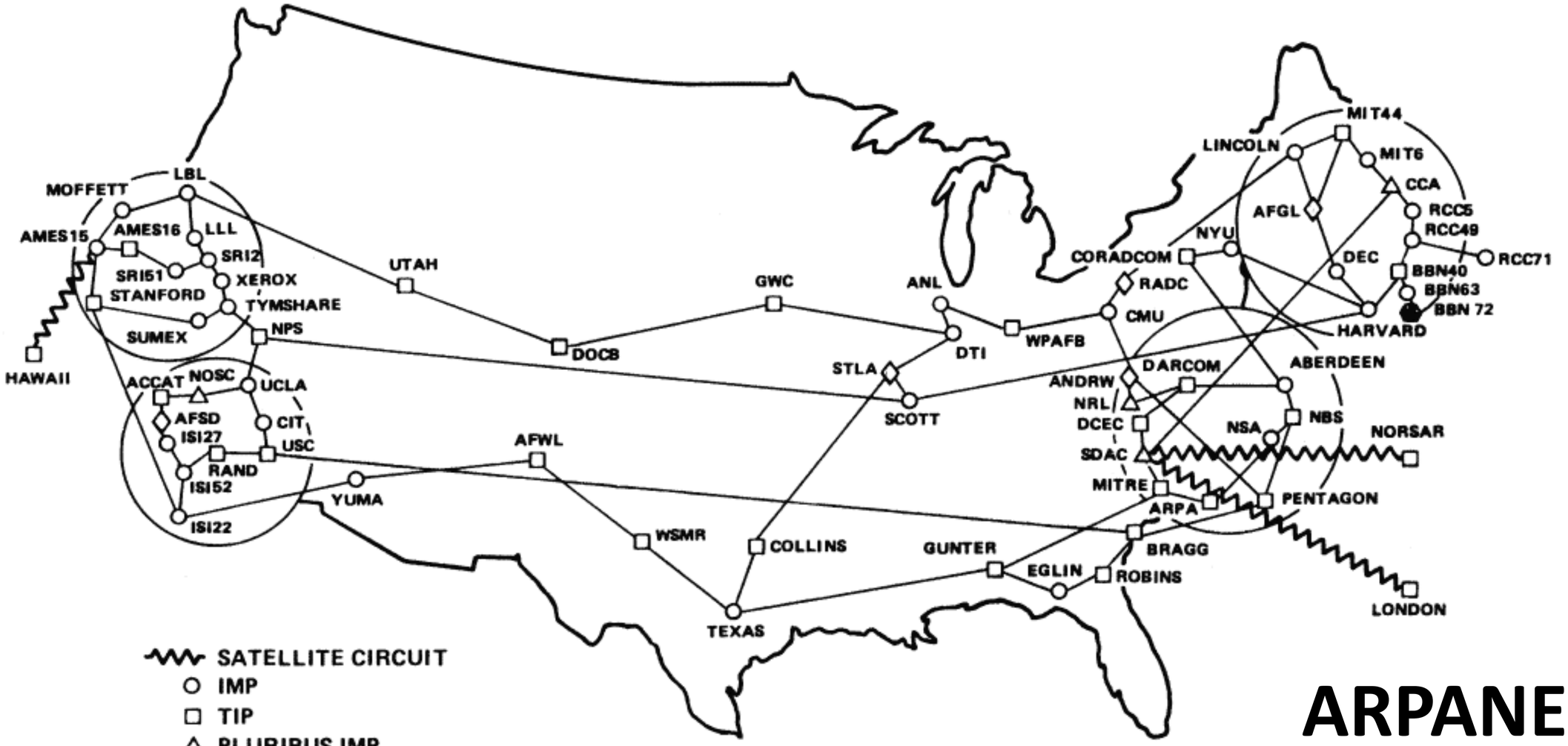
1. Fiat

2. Guarantor

3. Consensus, Transparency

bitcoin

Internet-Scale Routing, Membership



ARPANET, 1980

Contract Virtualization

Satoshi's World

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Satoshi Nakamoto
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Decentralized

Chained Proof-of Work

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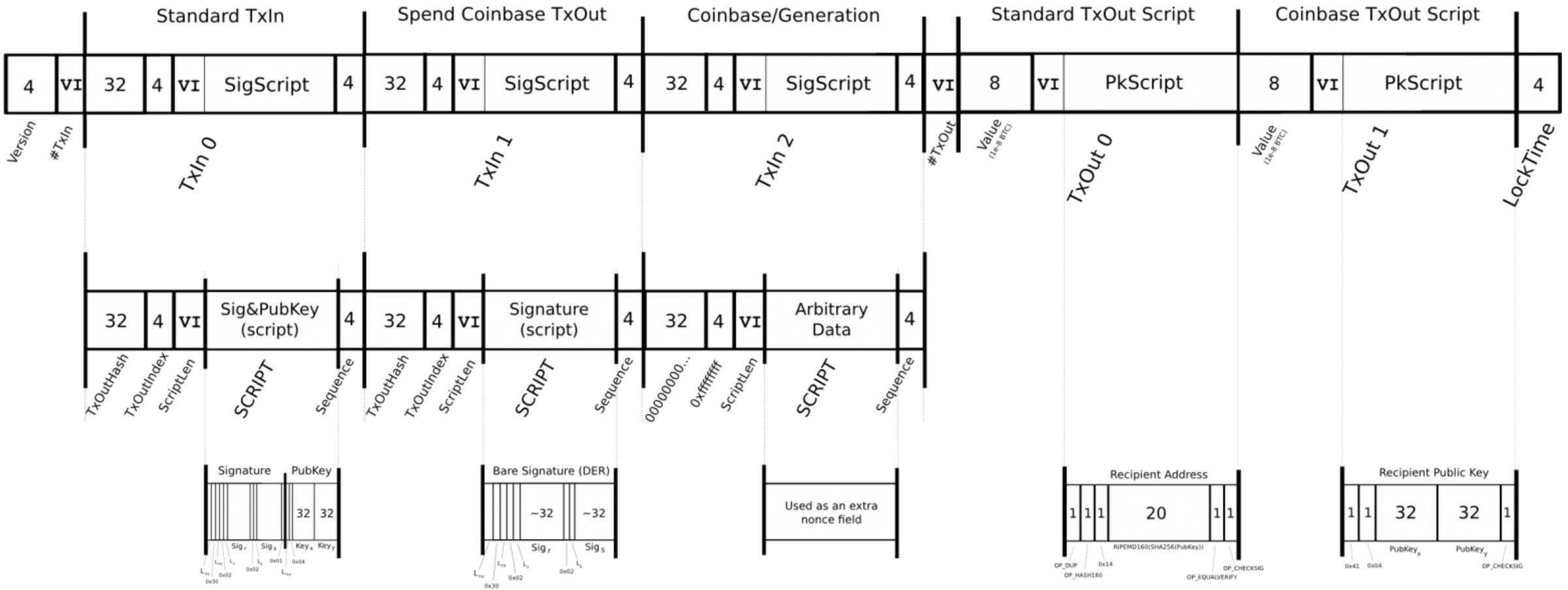
HVF Labs

ben@hvflabs.com

Transaction



Scripts and DER encoding both use big-endian values, all other serializations use little-endian

etotheipi@gmail.com / 1Gffm7LKXcNFPrtxy6yF4JBoe5rVka4sn1