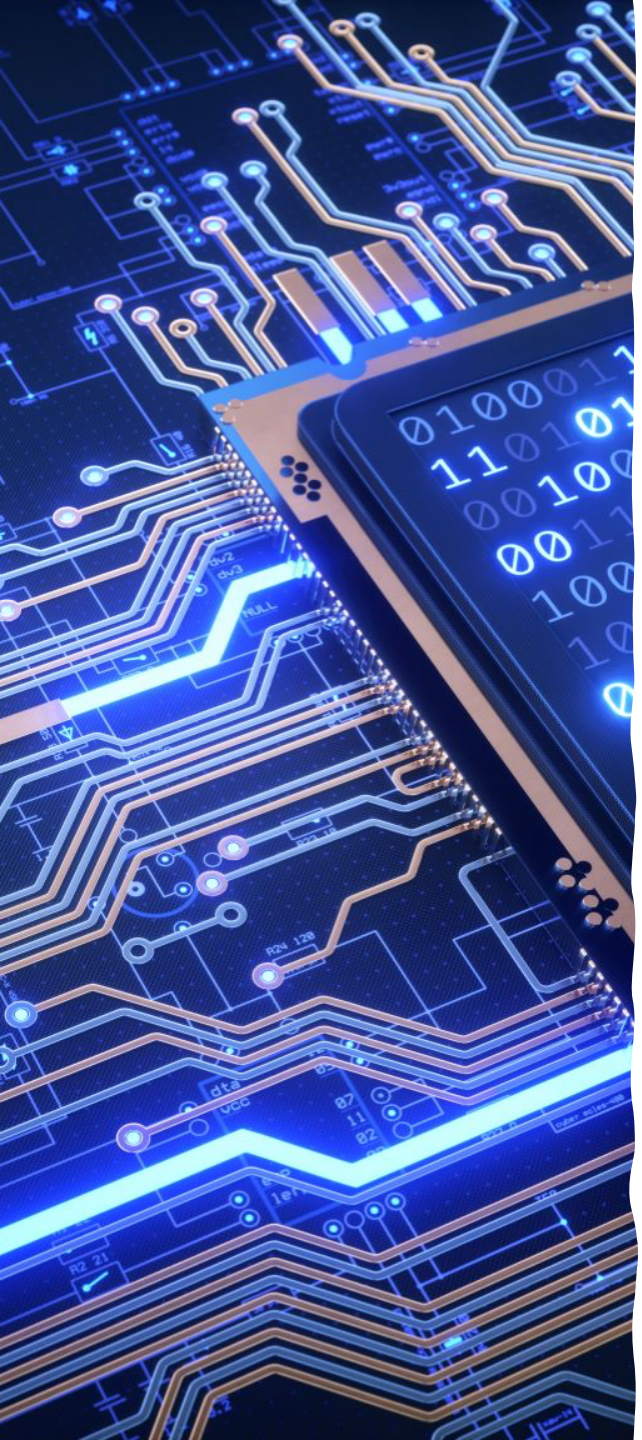

IoT and Blockchain

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Outline

What data are we transferring?

Sustaining blockchains

Ledgers

Generating Blocks on RPIs

ClockChains

IoT and Properties of Blockchain

Autonomous nodes

Immutability

Verifiability

→ Consensus based

Data

Account numbers: public keys

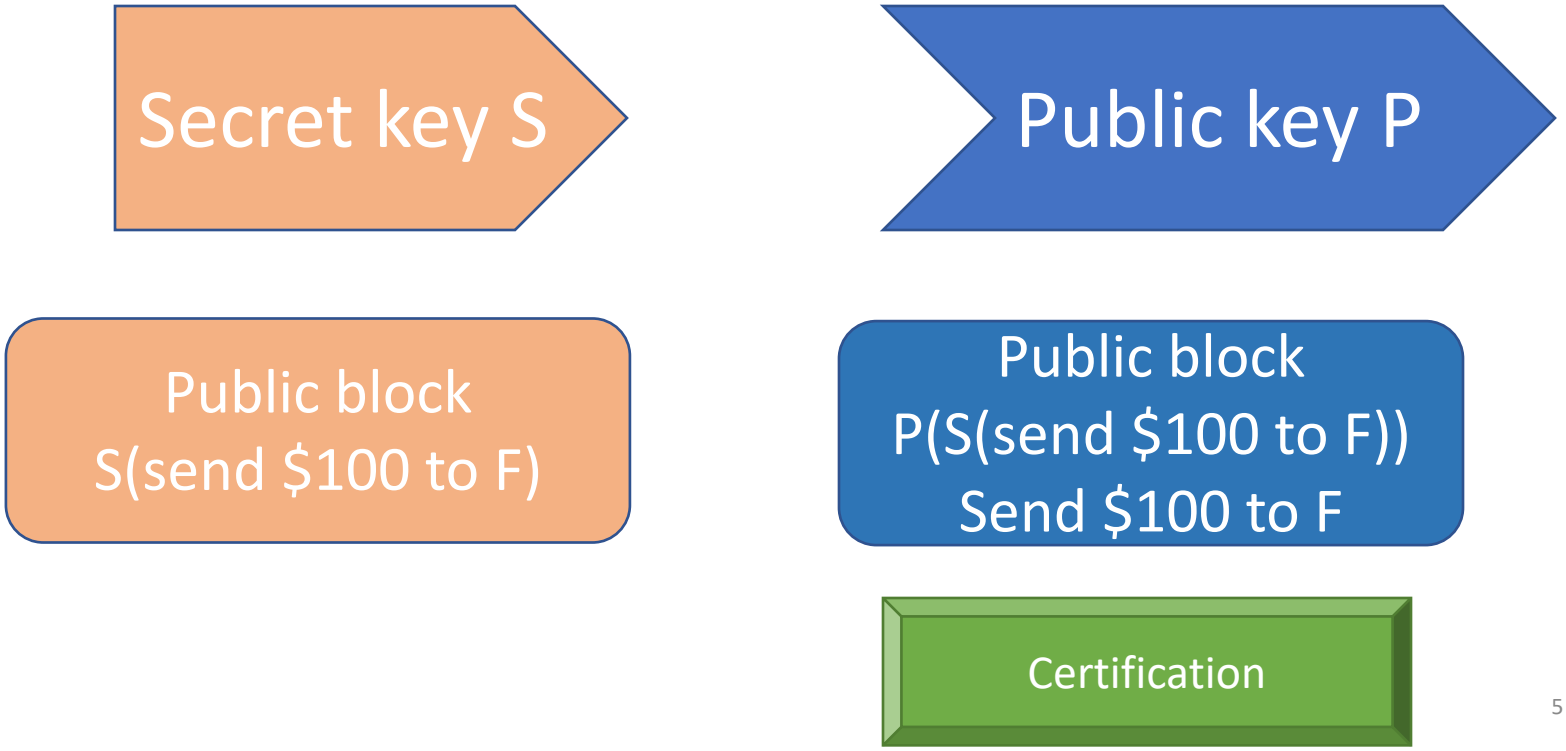
- Anyone can send you a message securely
- Transfer resources
- Intractable to get your secret key

Signatures by private keys

- Verify signature using public key

Data

If Alan-T wants to send you digital money how do they do it?



Data

Alan-T

1. Determines the amount to send you
2. Takes to-public-key
3. Compute S(amount, to-public-key)

[S(amount, to-public-key), from-public-key]

Verification?

Pay yourself first

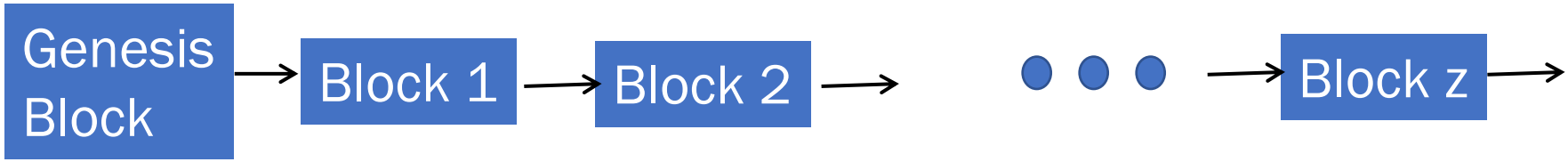
Each miner inserts a payment to themselves

This self-pay is pre-agreed upon

xfers {
[S(amount, to-public-key), from-public-key ;
. . .
]
}

Also, can require a transaction fee!

Blockchain: public ledger



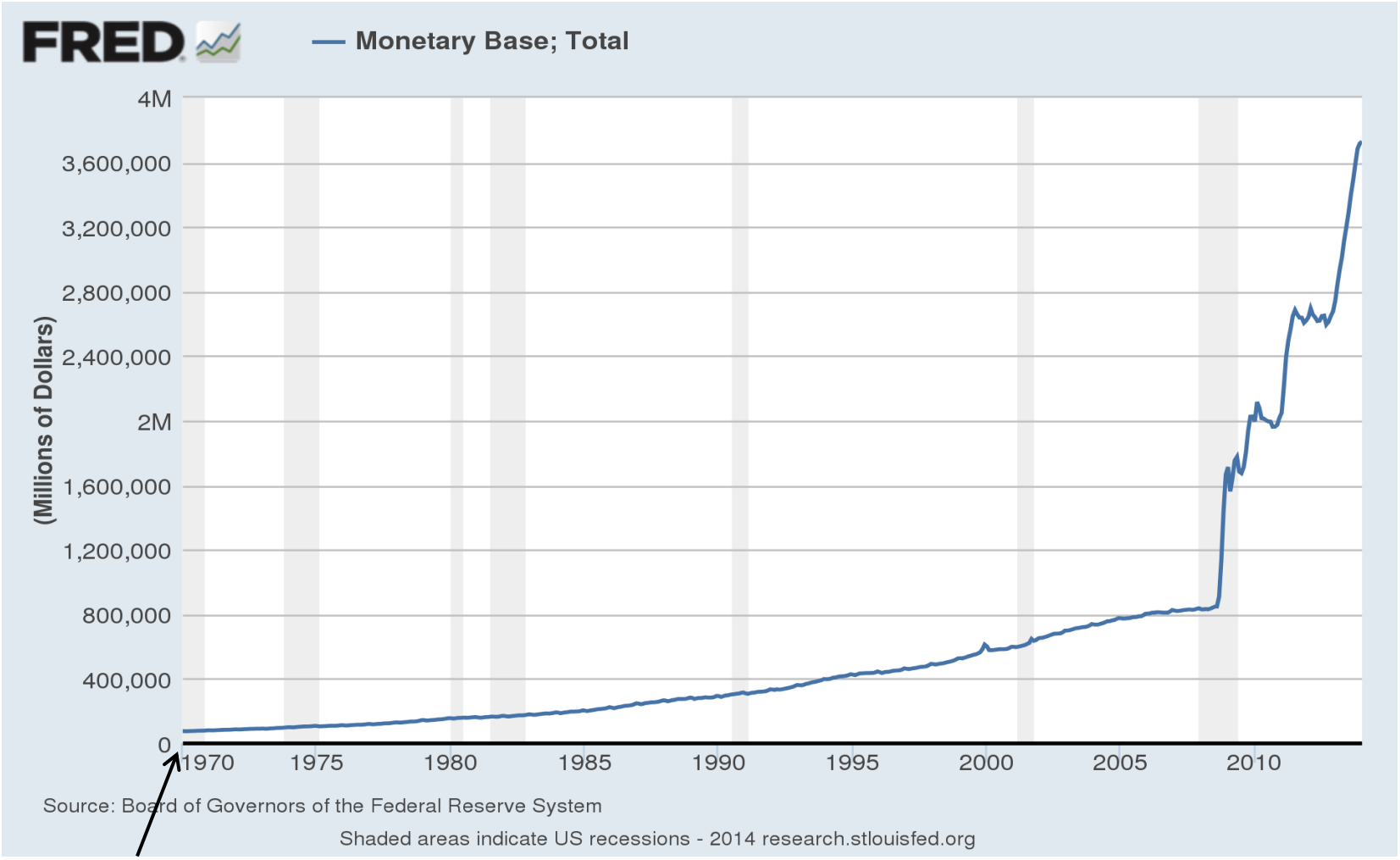
All transactions in blocks

New block about every X seconds

Can trade all money from the start

https://blockchain.info/

US Money Supply



First Unix-day

Bitcoin example

Max of about 21 million total Bitcoins by 2140

Geometric series

$50 + 25 + 12.5 + 6.25 + 3.125 + 1.5625 + \ldots$

Last term about $\frac{1}{100{,}000{,}000}$!

Last term takes about 33*4 = 132 years

New Bitcoins

About ever 10 minutes

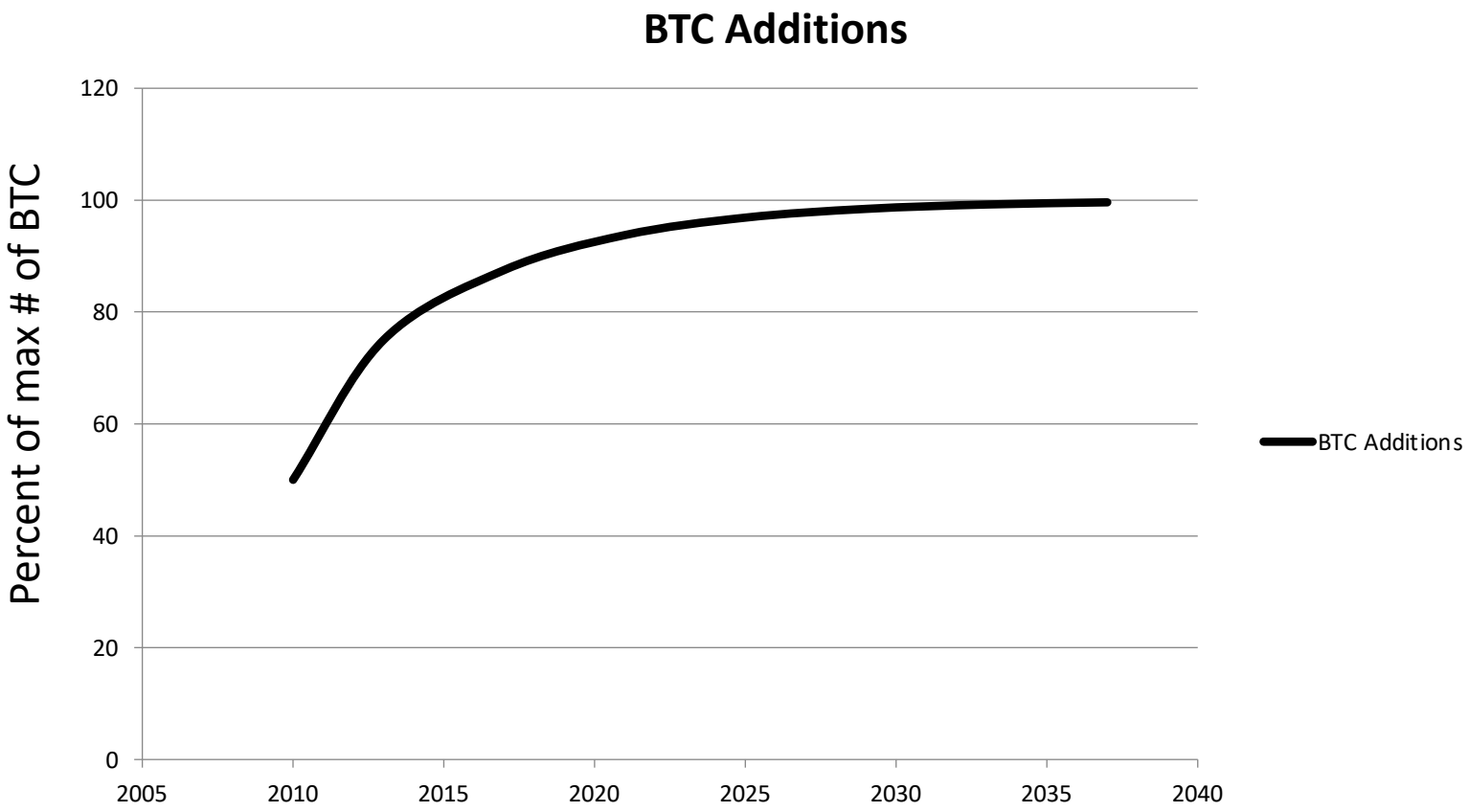
Halve amount added ever 4 years

- 2009-2013: add 50 BTC every ~10 minutes
- 2014-2017: add 25 BTC every ~10 minutes
- 2018-2021: add 12.5 BTC every ~10 minutes
- 2022-2025: add 6.25 BTC every ~10 minutes
- .

Last year for new BTC is 2140

- Almost none added after 2030

Bitcoin Supply



Money Purpose & Properties

Purpose
- Medium of exchange
- Unit of account
- Store of value

Properties
- Opportunities for earning & commerce
- Safety, stability, supply, storage
- Fungibility, divisibility, liquidity, exchange & transfer
- Opportunity for investment

Money - Technology Dependent

5,000 BC – metal money

760 BC – coins

960 AD – paper money

2009 – operating digital currency Bitcoin
Satoshi Nakamoto
See also Chaum 1982

Blockchain Currencies

No central authority

Seignorage – difference in cost of making money and its value

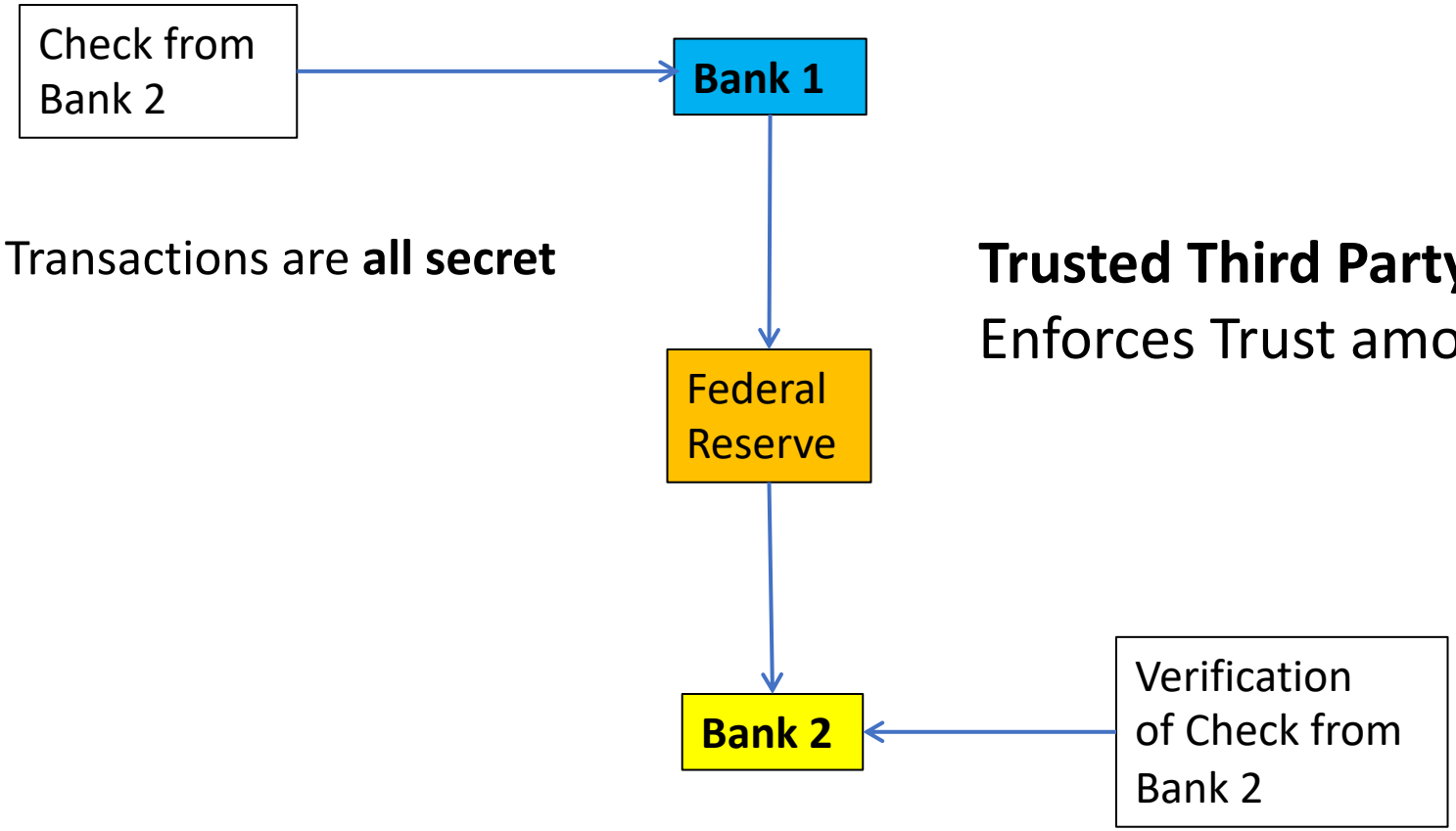
- Seignorage to miners not a central bank
  - Bottom up rather than current top-down
- Transaction fees

Legal tender issues

Jurisdiction issue

Privacy model: Classic

The user & firms are responsible for the secret keys



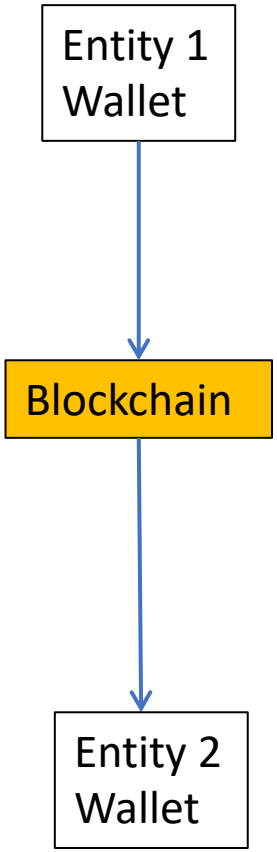
Transactions are **all secret**

Trusted Third Party

Enforces Trust among banks

Privacy model: Bitcoin

The user is responsible for the secret keys & security



All Transactions public
Anonymity is up to individuals

Verified Trust Enforces Trust among banks

Large-scale IoT Economics

Distributed ledger

Autonomous

Paying nodes to support the network – mining

“Want weak currency now, strong currency in the future”

Clockchains are not Blockchains

Mine on RPI_1

```
import paramiko

RPI_1 = paramiko.SSHClient()

RPI_1.set_missing_host_key_policy(paramiko.AutoAddPolicy())
RPI_1.connect(hostname='localhost',username='pi',port=5022)

stdout=RPI_1.exec_command('python3 testMine.py')
output = stdout.readlines()
for items in output:
    print("RPI_1:" + items)

RPI_1.close()
```

Two RPI synchronous test

```
RPI_1.connect(hostname='localhost',username='pi',port=5022,password=
RPI_2.connect(hostname='localhost',username='pi',port=5023,password=

stdin,stdout,stderr=RPI_2.exec_command('python3 testMine.py ' + "3")
output = stdout.readlines()
for items in output:
    print("RPI_2:" + items)

stdin,stdout,stderr=RPI_1.exec_command('python3 testMine.py ' + "2")
output = stdout.readlines()
for items in output:
    print("RPI_1:" + items)
```

Two non-RPI Almost-Clock-Chain

```
class AlmostClockChain(threading.Thread):
    def __init__(self, name, difficulty):
        threading.Thread.__init__(self)
        self.name = name
        self.difficulty = difficulty

    def run(self):
        print("Starting thread "+self.name+"\n")
        tm = TestMine(self.difficulty)

t1=AlmostClockChain("Non-RPI_1",5)
t2=AlmostClockChain("Non-RPI_2",3)
t1.start()
t2.start()
```

Two RPI ClockChains

See code

ClockChain.py

Where to from here?