

Plan of Attack

What we will learn in this section:

- What is Bitcoin?
- Bitcoin's Monetary Policy
- Understanding Mining Difficulty
- Virtual tour of a Bitcoin Mine
- Mining Pools
- Nonce Range
- How Miners Pick Transactions (Part 1)
- How Miners Pick Transactions (Part 2)
- CPUs vs GPUs vs ASICs
- How do Mempools work?
- Orphaned blocks
- The 51% Attack
- Extra: Bits to Target conversion

What is Bitcoin?

TECHNOLOGY

Blockchain

PROTOCOL / COIN /

Waves



Ethereum



Bitcoin



Neo



Ripple



TOKEN

WCT

B1

WGR

INTL

TRX

AE

REP

SNT

RHOC

MKR

PPT

BNB



ACAT

TNC

DBC

RPX

QLC

TKY

ONT

IAM



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USD

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#	Name	Market Cap	Price	Volume (24h)	Circulating Supply	Change (24h)	Price Graph (7d)
1	Bitcoin	\$176,531,814,440	\$10,450.40	\$7,024,560,000	16,892,350 BTC	-2.53%	
2	Ethereum	\$84,083,264,467	\$858.81	\$1,976,370,000	97,906,257 ETH	-2.53%	
3	Ripple	\$35,514,031,070	\$0.908408	\$330,352,000	39,094,802,192 XRP *	-3.96%	
4	Bitcoin Cash	\$20,585,648,276	\$1,211.43	\$377,957,000	16,992,850 BCH	-2.86%	
5	Litecoin	\$11,344,800,770	\$204.69	\$767,655,000	55,424,033 LTC	-6.53%	
6	NEO	\$8,791,575,000	\$135.26	\$329,304,000	65,000,000 NEO *	-5.51%	
7	Cardano	\$8,014,187,139	\$0.309105	\$118,508,000	25,927,070,538 ADA *	-7.56%	
8	Stellar	\$6,274,679,110	\$0.339758	\$39,087,800	18,468,083,489 XLM *	-5.60%	
9	EOS	\$5,934,048,965	\$8.50	\$389,991,000	698,387,151 EOS *	-1.67%	
10	IOTA	\$5,166,563,095	\$1.86	\$38,838,600	2,779,530,283 MIOTA *	-6.36%	
11	Dash	\$4,619,560,691	\$583.85	\$100,498,000	7,912,280 DASH	-5.13%	
12	Monero	\$4,527,396,659	\$287.01	\$47,355,100	15,774,132 XMR	-4.53%	
13	NEM	\$3,576,996,000	\$0.397444	\$27,604,700	8,999,999,999 XEM *	-2.45%	
14	Ethereum Classic	\$3,345,636,178	\$22.39	\$502,434,000	100,192,146 ETC	-7.21%	

Microsoft

Storage that grows with you.

Cloud storage with a range of solutions for your needs.

TRY AZURE FREE →

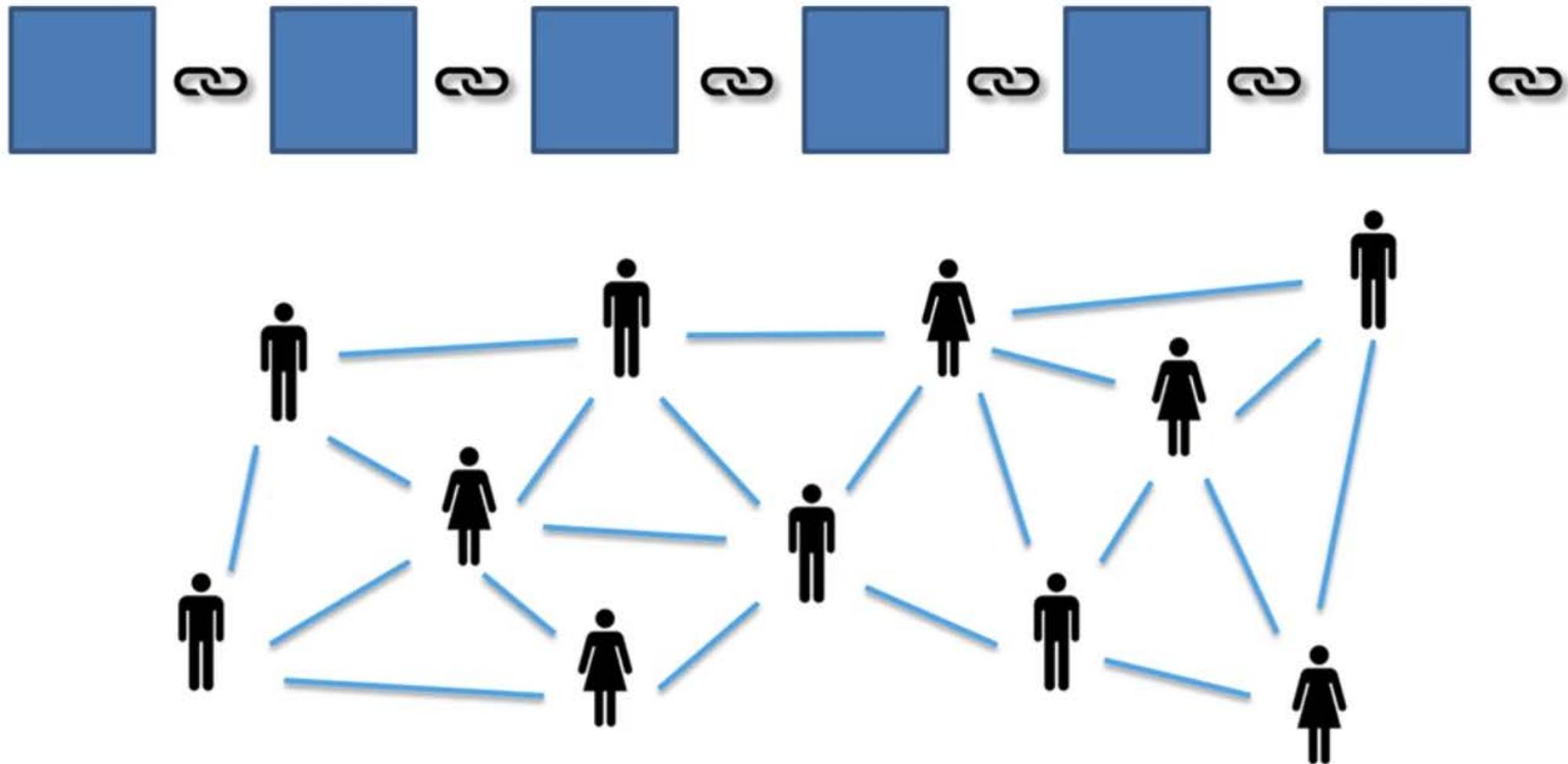
Microsoft Azure

What is Bitcoin?



Satoshi Nakamoto

What is Bitcoin?



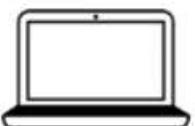
What is Bitcoin?

The Bitcoin Ecosystem:

- Nodes



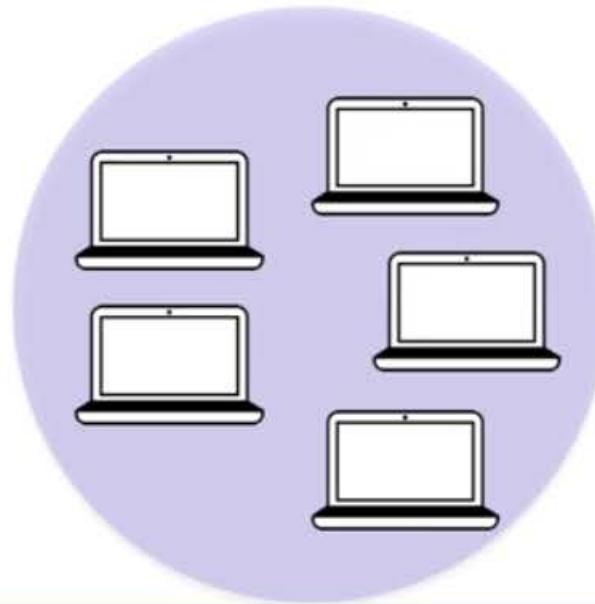
- Miners



- Large Mines



- Mining Pools



Bitcoin's Monetary Policy

The Halving

~2020: 6.25

~2024: 3.125

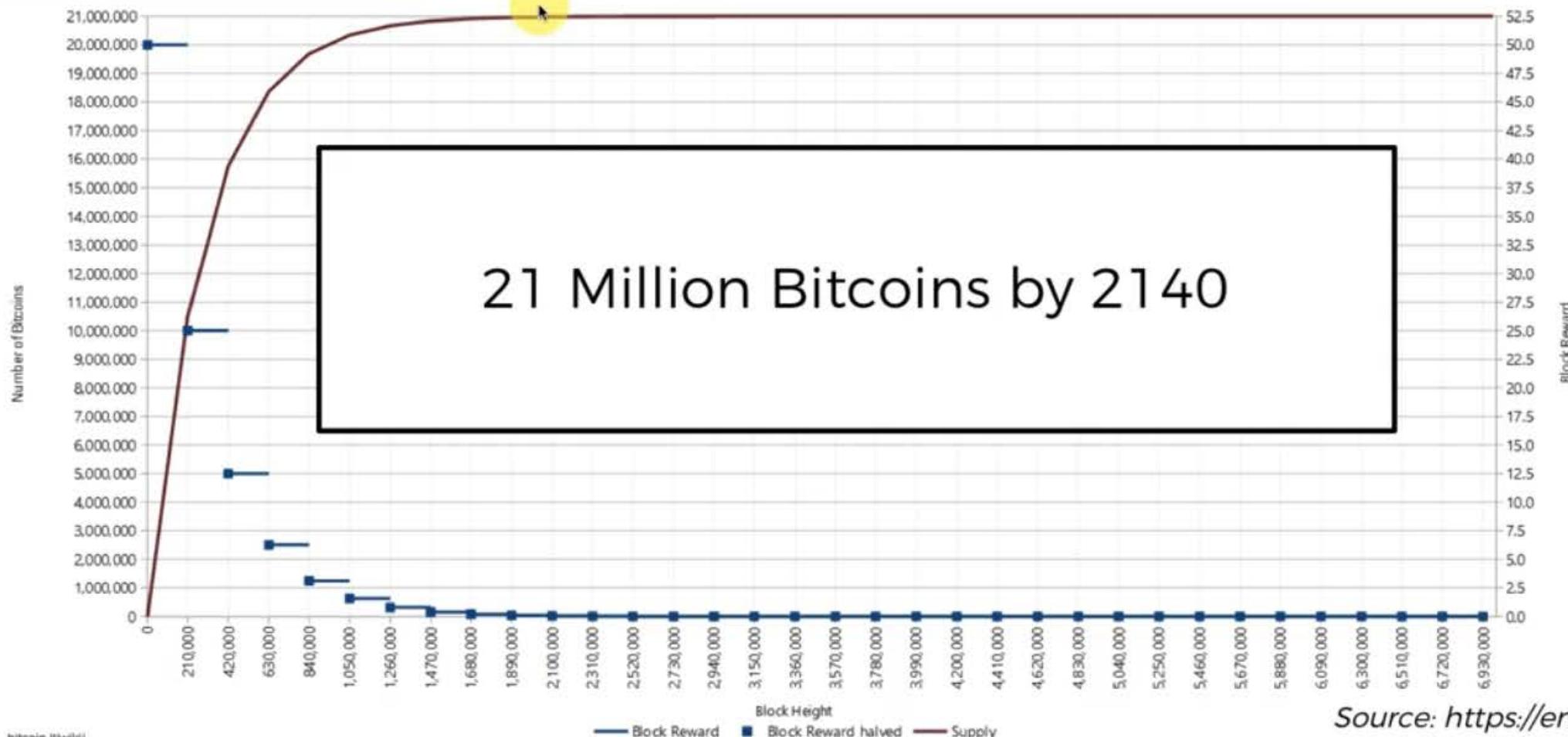
Date reached	Block	Reward Era	BTC/block
2009-01-03	0	1	50.00
2010-04-22	52500	1	50.00
2011-01-28	105000	1	50.00
2011-12-14	157500	1	50.00
2012-11-28	210000	2	25.00
2013-10-09	262500	2	25.00
2014-08-11	315000	2	25.00
2015-07-29	367500	2	25.00
2016-07-09	420000	3	12.50
2017-06-23	472500	3	12.50

Bitcoin's Monetary Policy

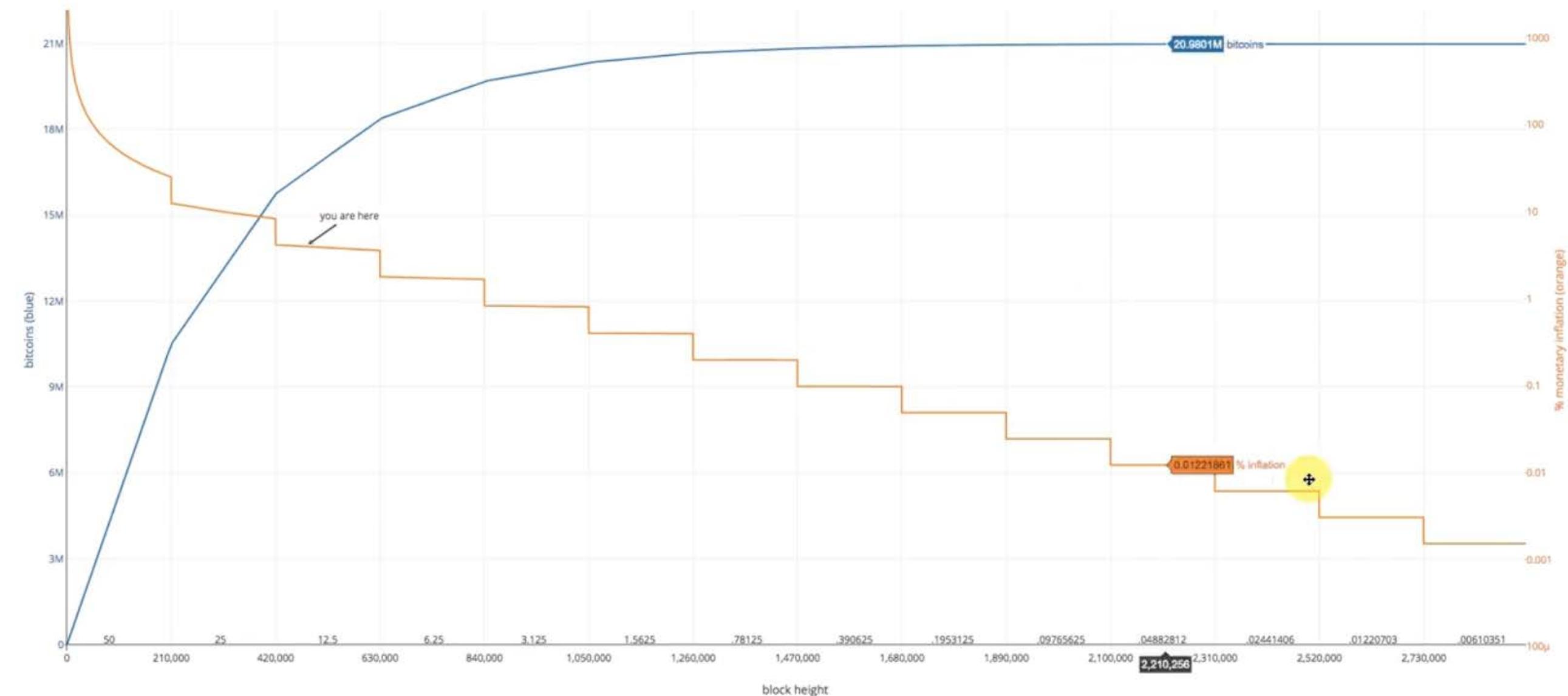
The Halving

Bitcoin - Controlled Supply

Number of bitcoins as a function of Block Height



Bitcoin Monetary Inflation



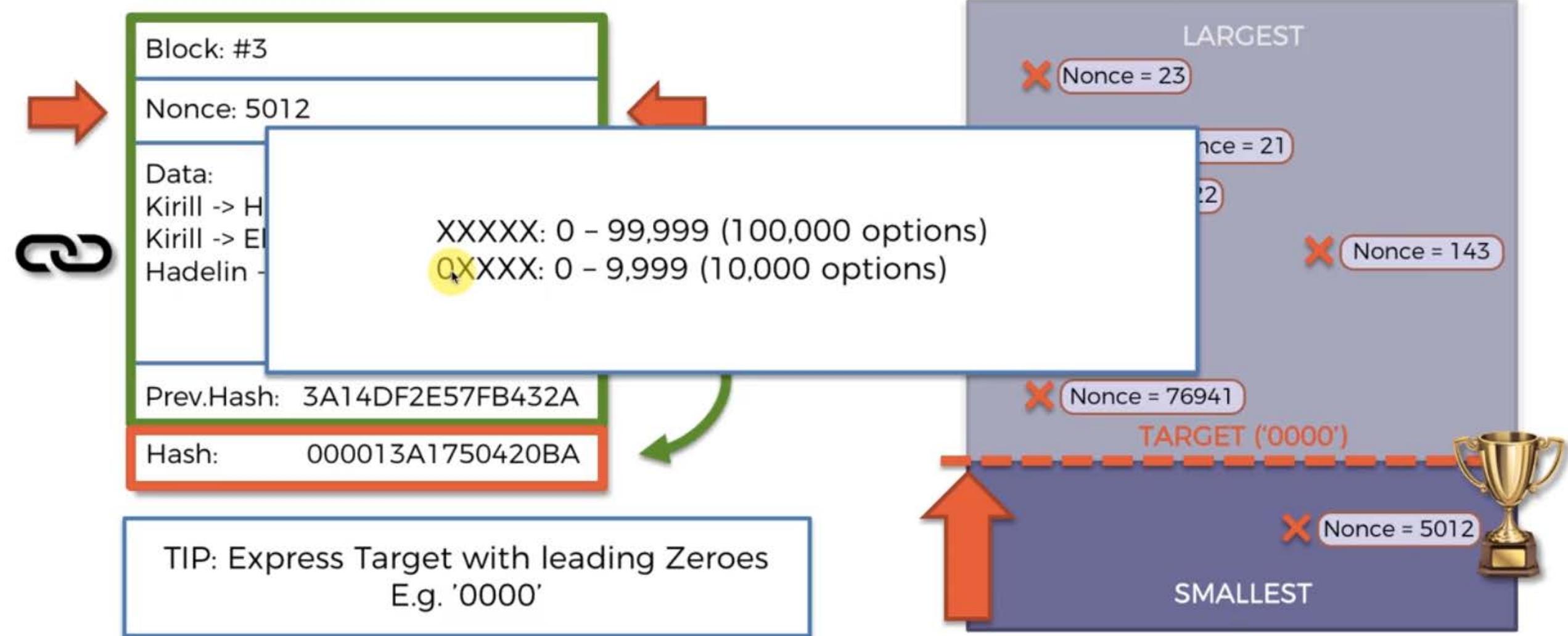
Understanding Mining Difficulty

Today we will answer these questions:

- What is the Current Target and how does that *feel*?
- How is “Mining Difficulty” calculated?

Understanding Mining Difficulty

- ALL POSSIBLE HASHES -



Understanding Mining Difficulty

Current target =  18 zeros

Let's do some estimations:

Probability:

Total possible 64-digit hexadecimal numbers: $16 \times 16 \times \dots \times 16 = 16^{64} \approx 1.1579 \times 10^{77} \approx 10^{77}$
Total valid hashes (with 18 leading zeros): $16 \times 16 \times \dots \times 16 = 16^{64-18} \approx 2.4519 \times 10^{55} \approx 2 \times 10^{55}$

Probability that a Randomly picked hash is valid: $2 \times 10^{55} / 10^{77} = 2 \times 10^{-22} = 0.0000000000000000000002\%$

Block #510962

Summary

Number Of Transactions	945
Output Total	3,075.84952371 BTC
Estimated Transaction Volume	523.48294259 BTC
Transaction Fees	0.21695886 BTC
Height	510962 (Main Chain)
Timestamp	2018-02-26 07:24:44
Received Time	2018-02-26 07:24:44
Relayed By	BTC.com
Difficulty	3,007,383,866,429.73
Bits	392009692
Size	1035.821 kB
Weight	3992.87 kWU
Version	0x20000000
Nonce	2635453617
Block Reward	12.5 BTC

Hashes

Hash	0000000000000000000000000000000027d3a2756bba7df8c208ea687549e892d1031daf72a4f
Previous Block	0000000000000000000000000000000027d3a2756bba7df8c208ea687549e892d1031daf72a4f
Next Block(s)	
Merkle Root	425afaae6b21b95fc68aff4122146718862d094a965f5a6c5b43629e421a3d



Transactions

084329a550ea326d535a07116e7a3b859d1de3e1d05ce68f17af122ed019c18e

(Size: 243 bytes) 2018-02-26 07:24:44

No Inputs (Newly Generated Coins)

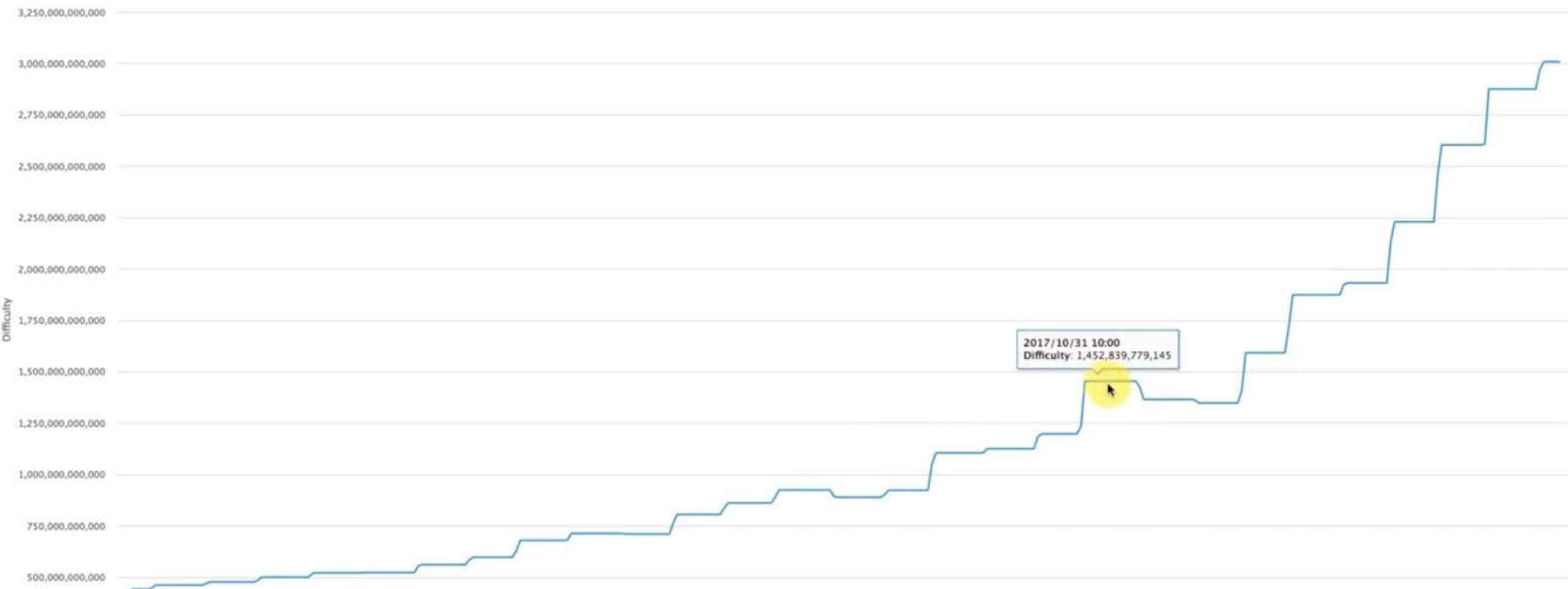
1C1mCxRukix1KfegAY5zQQJV7samAciZpv - (Unspent)
Unable to decode output address - (Unspent)12.71695886 BTC
0 BTC

12.71695886 BTC

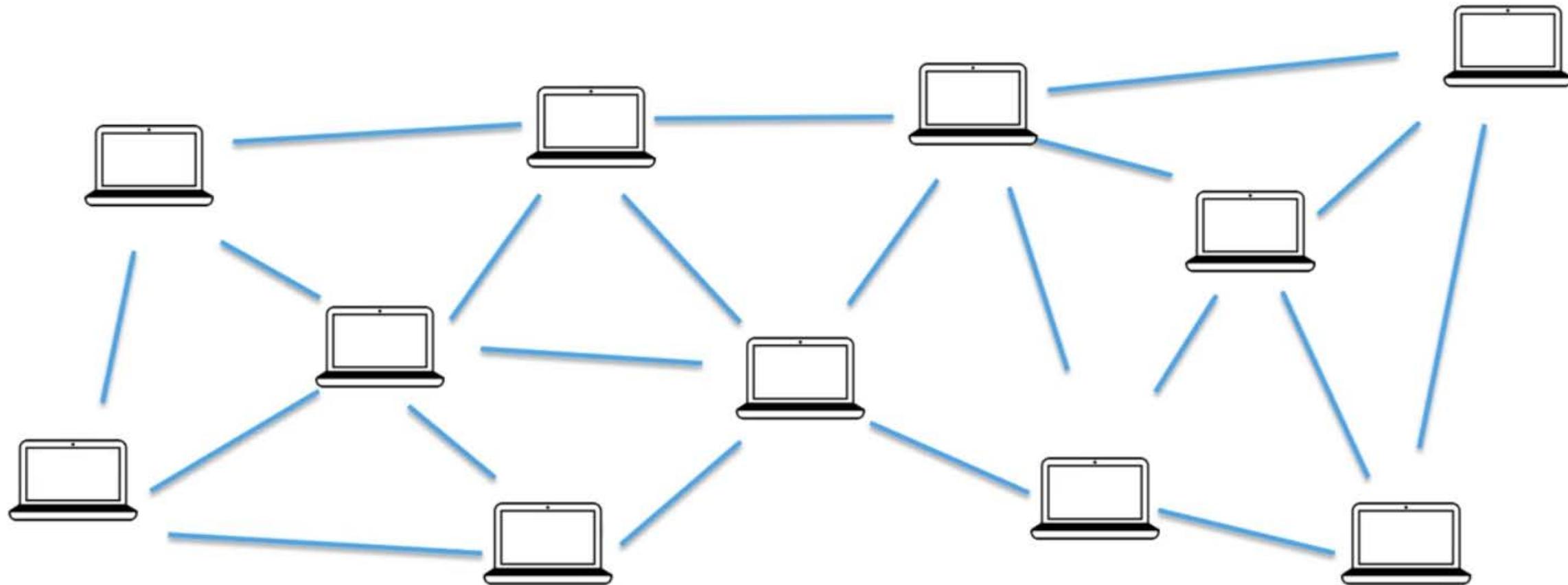
Difficulty

A relative measure of how difficult it is to find a new block. The difficulty is adjusted periodically as a function of how much hashing power has been deployed by the network of miners.

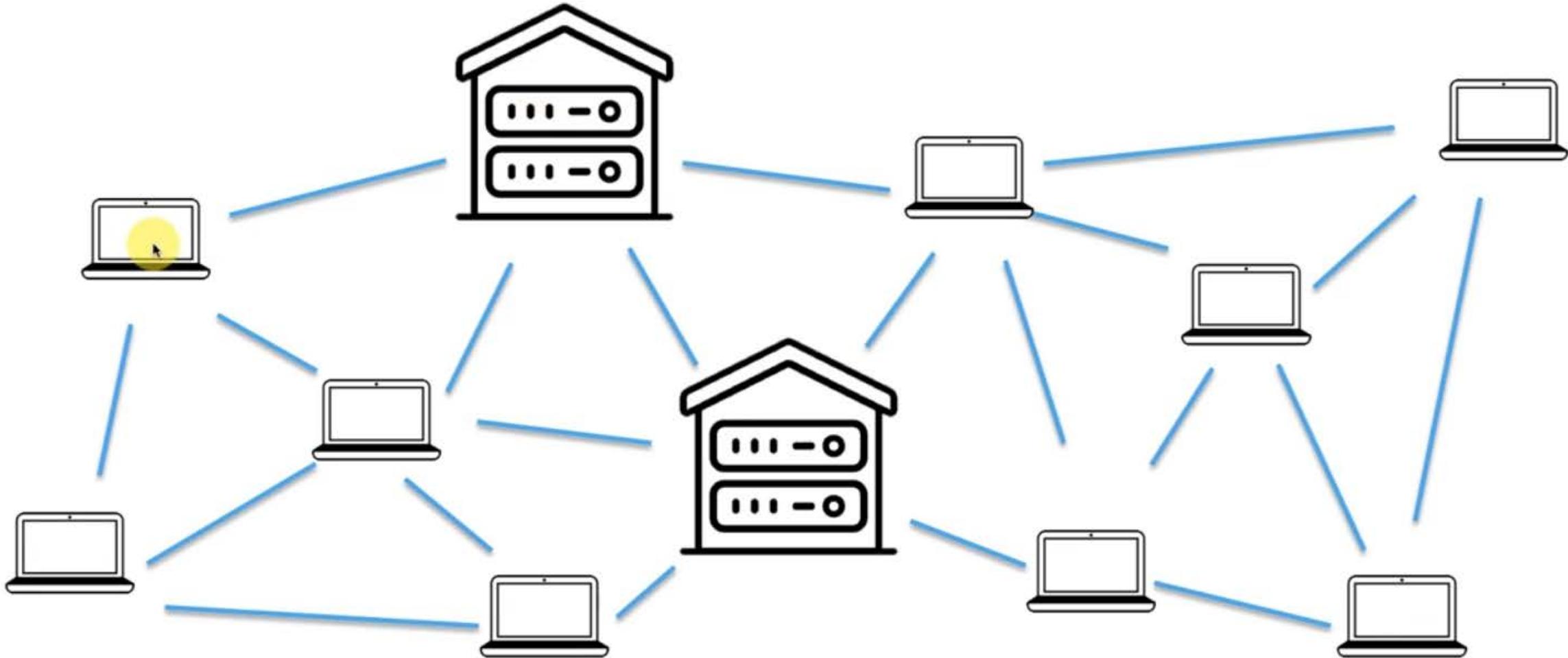
Source: blockchain.info



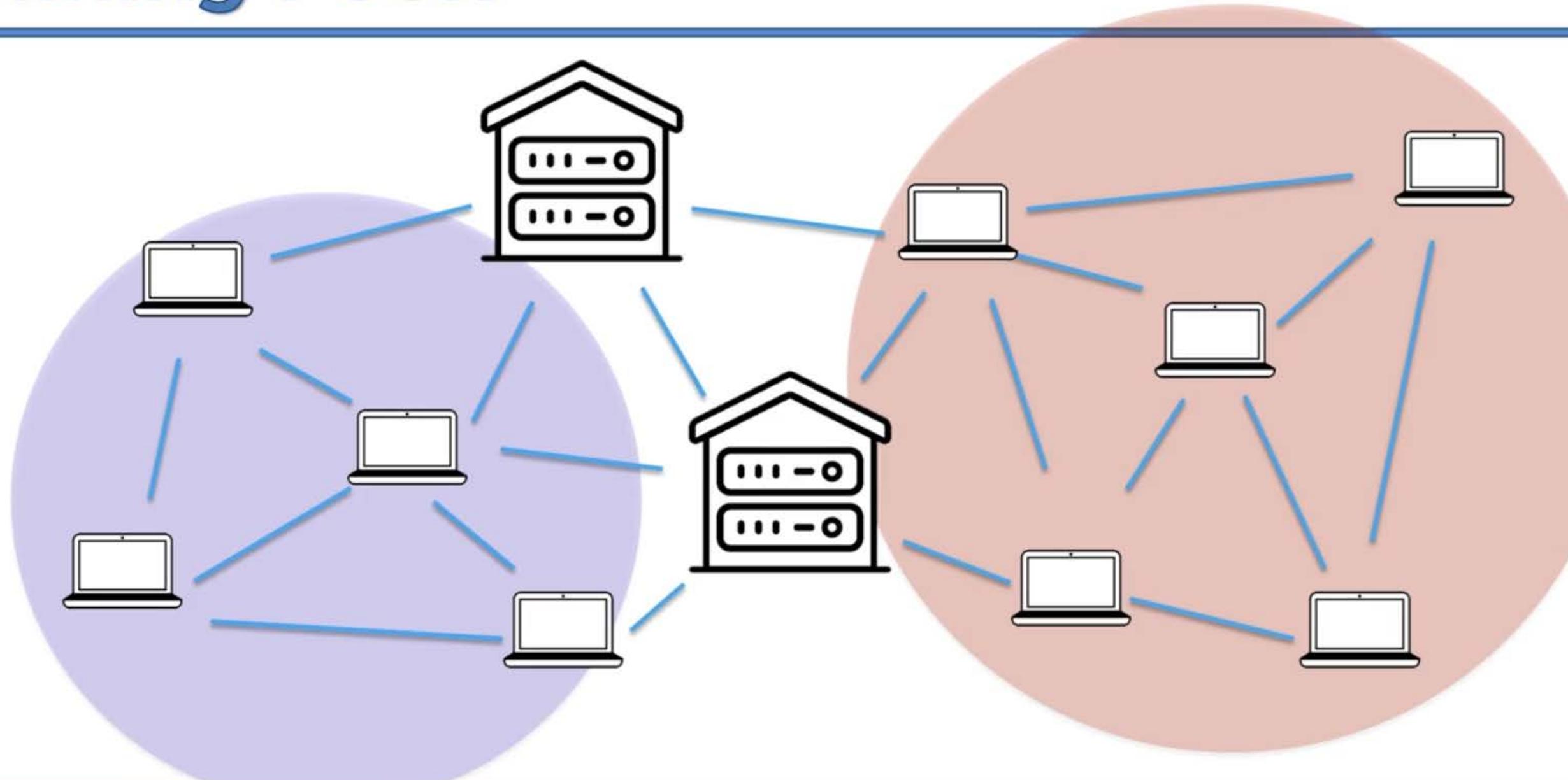
Mining Pools



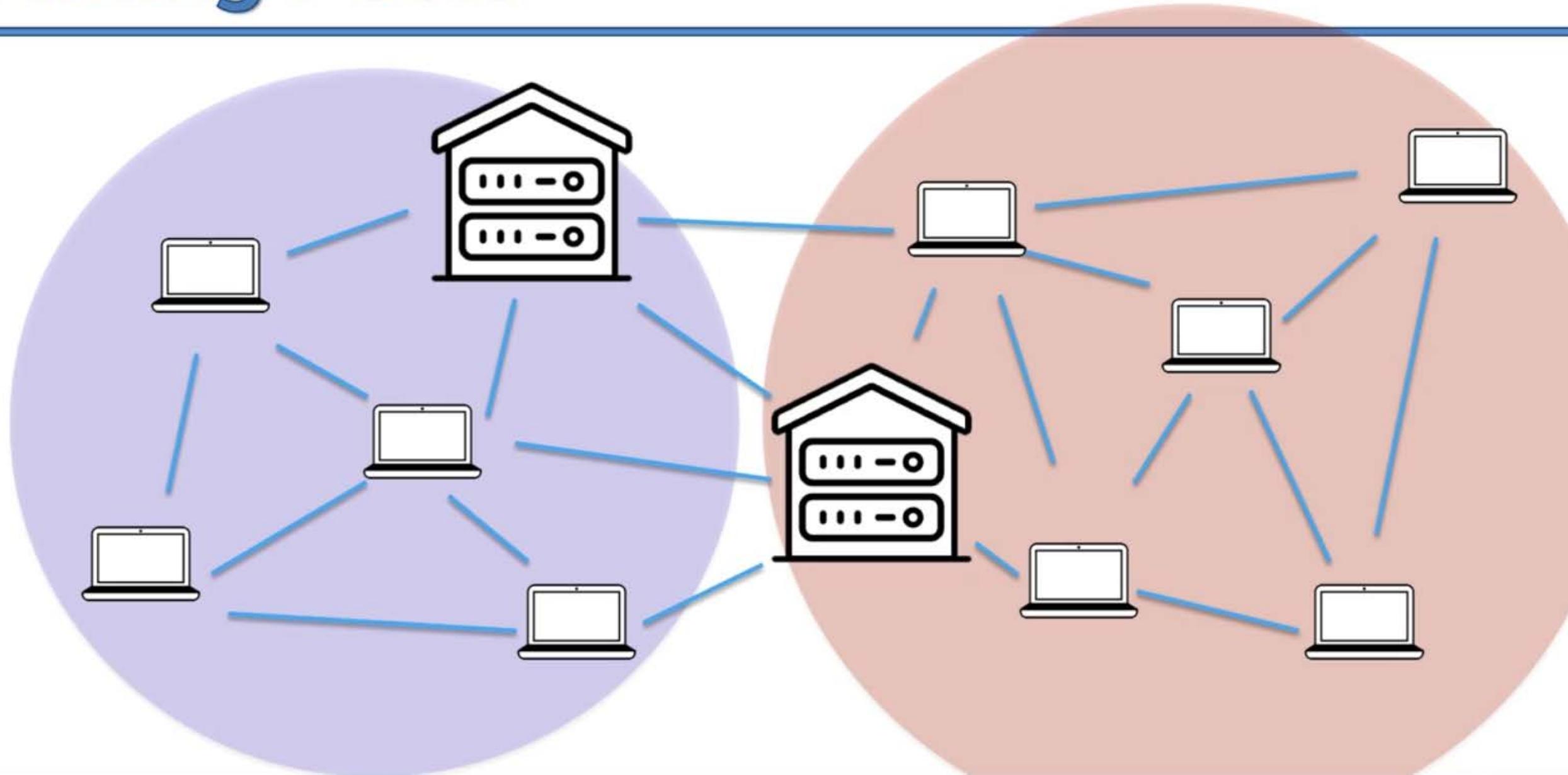
Mining Pools



Mining Pools



Mining Pools



mining pool's owner.

Miners can, however, choose to redirect their hashing power to a different mining pool at anytime.

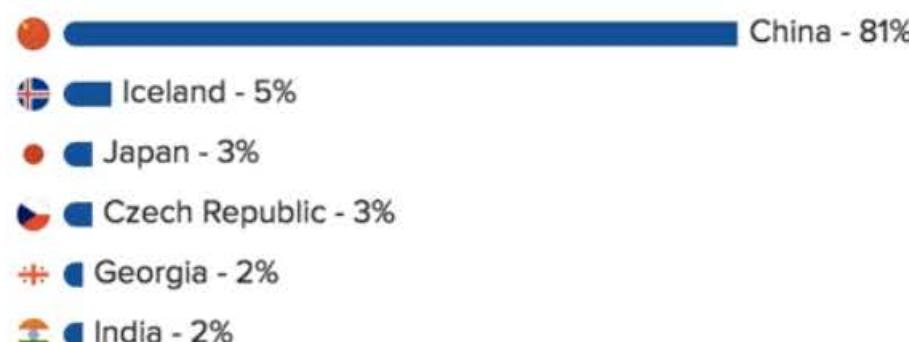


Pool Concentration in China

Before we get into the best mining pools to join, it's important to note that [most mining pools are in China](#). Many only have Chinese websites and support.

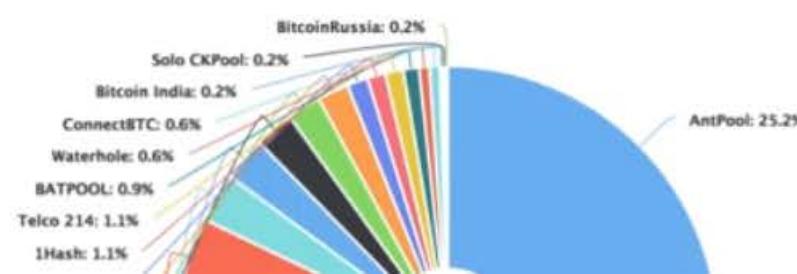
Mining centralization in China is one of Bitcoin's biggest issues at the moment.

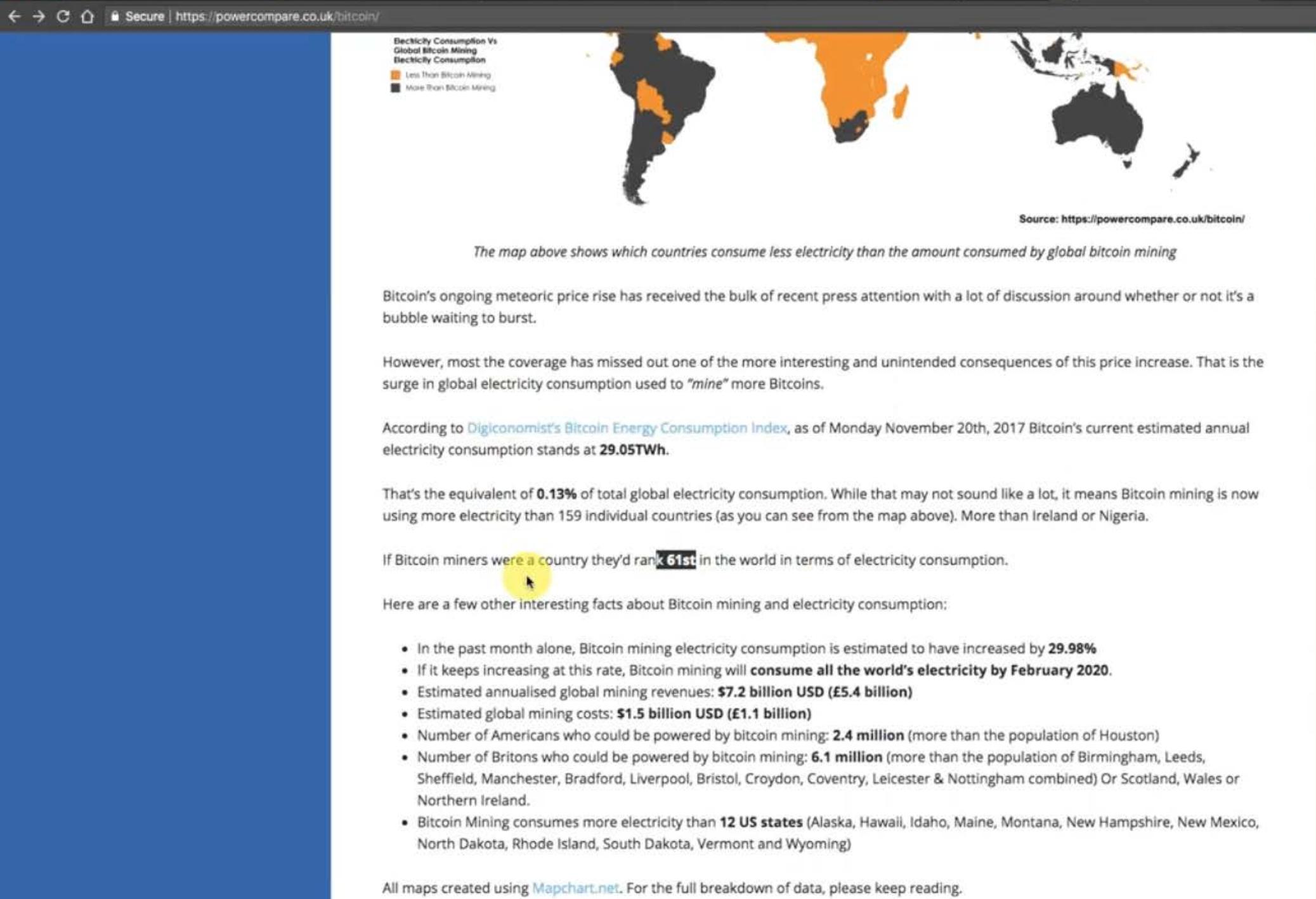
There are about 20 major mining pools. Broken down by the percent of hash power controlled by a pool, and the location of that pool's company, we estimate that Chinese pools control ~81% of the network hash rate:



The Biggest Mining Pools

The list below details the biggest Bitcoin mining pools. This is based on info from Blockchain's [pool share](#) chart:







2.3K



- [Bitcoin uses as much energy as 520,000 Canadians every day](#)
- [Bitcoin uses as much energy as the Democratic Republic of Congo](#)
- [Bitcoin uses more energy than 116 countries each](#)
- [Bitcoin uses enough energy to power 6 Nimitz-class aircraft carriers](#)

It is also easy to make this number look very small:

- [The energy that Bitcoin consumes in a year would only last the U.S. for 19 hours.](#)
- [Bitcoin uses only 20% of the energy from a single coal power plant in Taiwan](#)
- [The Three Gorges Damn in China produces three times as much electricity as Bitcoin consumes](#)
- [The U.S. produces more electricity from a single Geothermal plant than Bitcoin requires](#)
- [17 NSA Data centers together consume more electricity than Bitcoin](#)
- [Google used about double as much electricity in 2015 than Bitcoin does today](#)

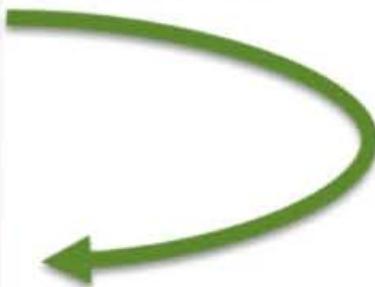
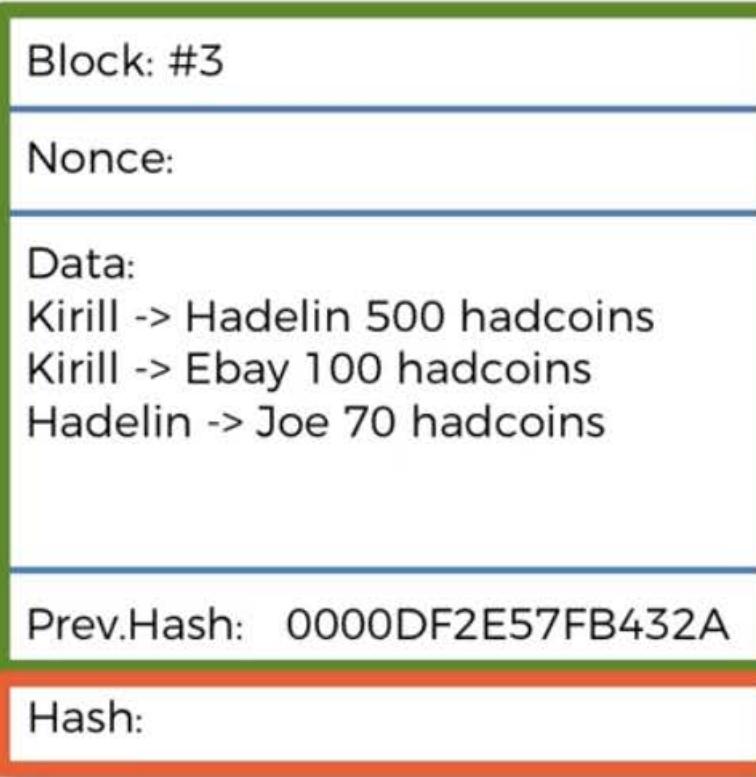
What does the future of Bitcoin mining look like?

Bitcoin currently consumes mostly very cheap electricity. Miners race to the bottom of who can find the cheapest electricity, and everyone consuming



Nonce Range

32-bit number



Nonce Range

Let's do some estimations:

Difficulty:

Total possible 64-digit hexadecimal numbers: $16 \times 16 \times \dots \times 16 = 16^{64} \approx 10^{77}$

Total valid hashes (with 18 leading zeros): $16 \times 16 \times \dots \times 16 = 16^{64-18} \approx 2 \times 10^{55}$

Probability that a Randomly picked hash is valid: $2 \times 10^{55} / 10^{77} = 2 \times 10^{-22} = 0.0000000000000000000002\%$

Nonce:

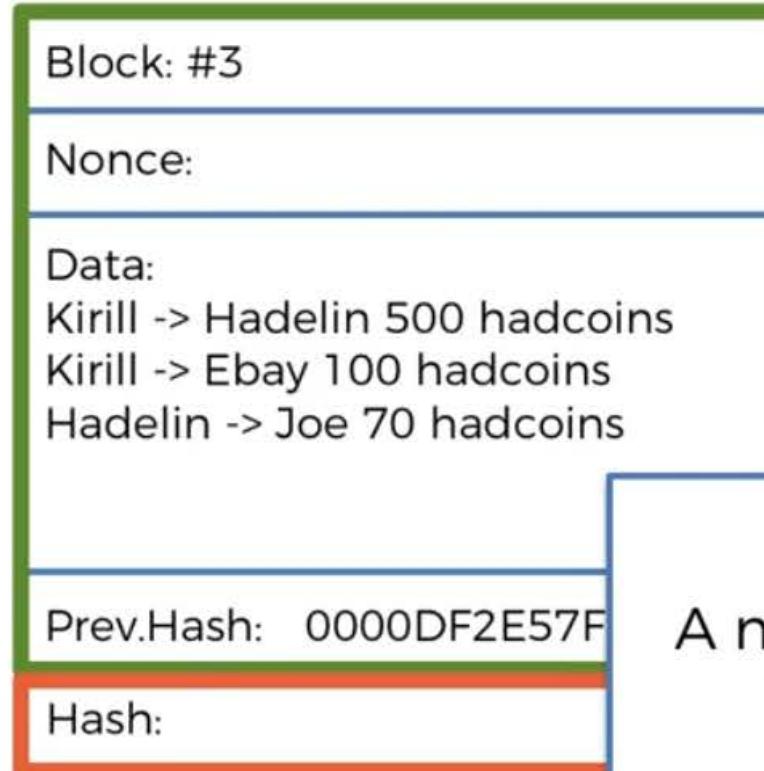
The Nonce is a 32-bit number, the Max Nonce = $2^{32} = 4,294,967,296 = 4 \times 10^9$

Assuming no collisions, this means 4×10^9 different hashes

Probability that ONE of them will be valid: $4 \times 10^9 \times 2 \times 10^{-22} = 8 \times 10^{-13} \approx 10^{-12} = 0.0000000001\%$

Conclusion: One Nonce Range is not enough

Nonce Range

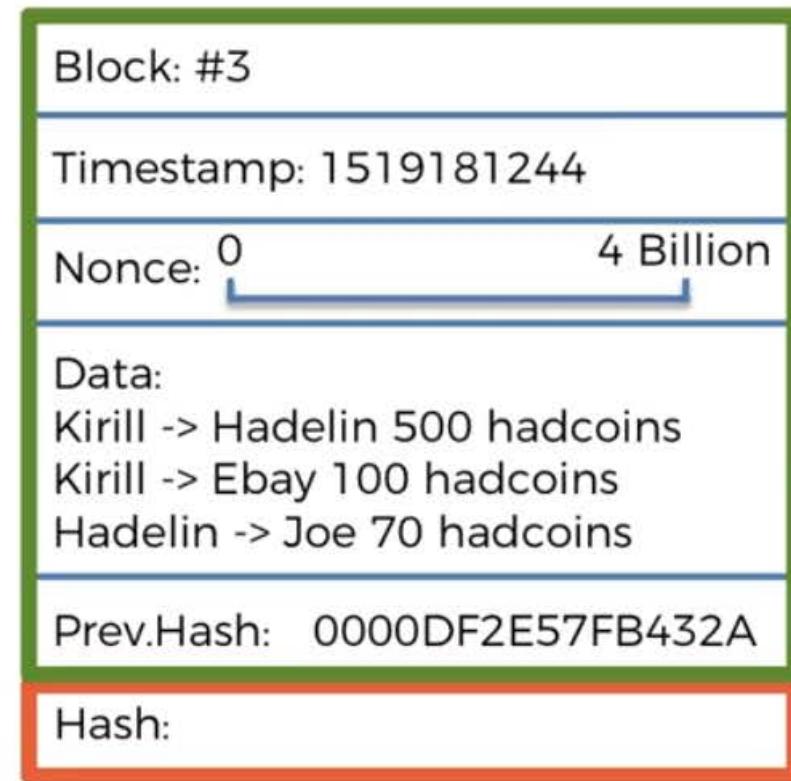


A modest miner does 100 MH/s
That's 100 Million Hashes
 $4\text{ Billion} / 100\text{ Million} = 40\text{ seconds}$

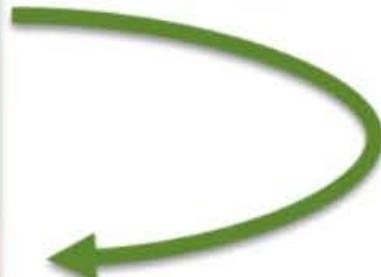
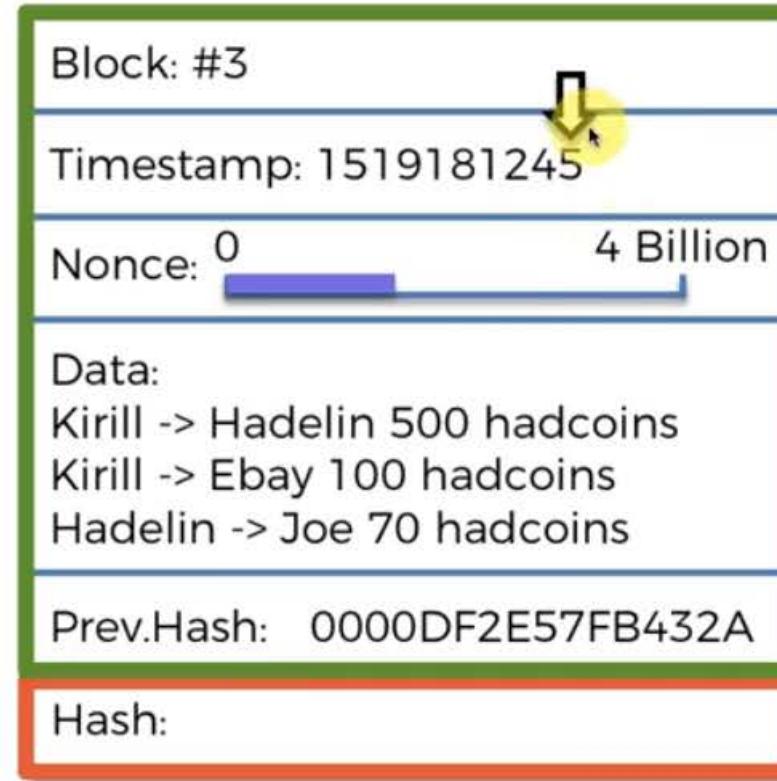
Nonce Range



Nonce Range



Nonce Range

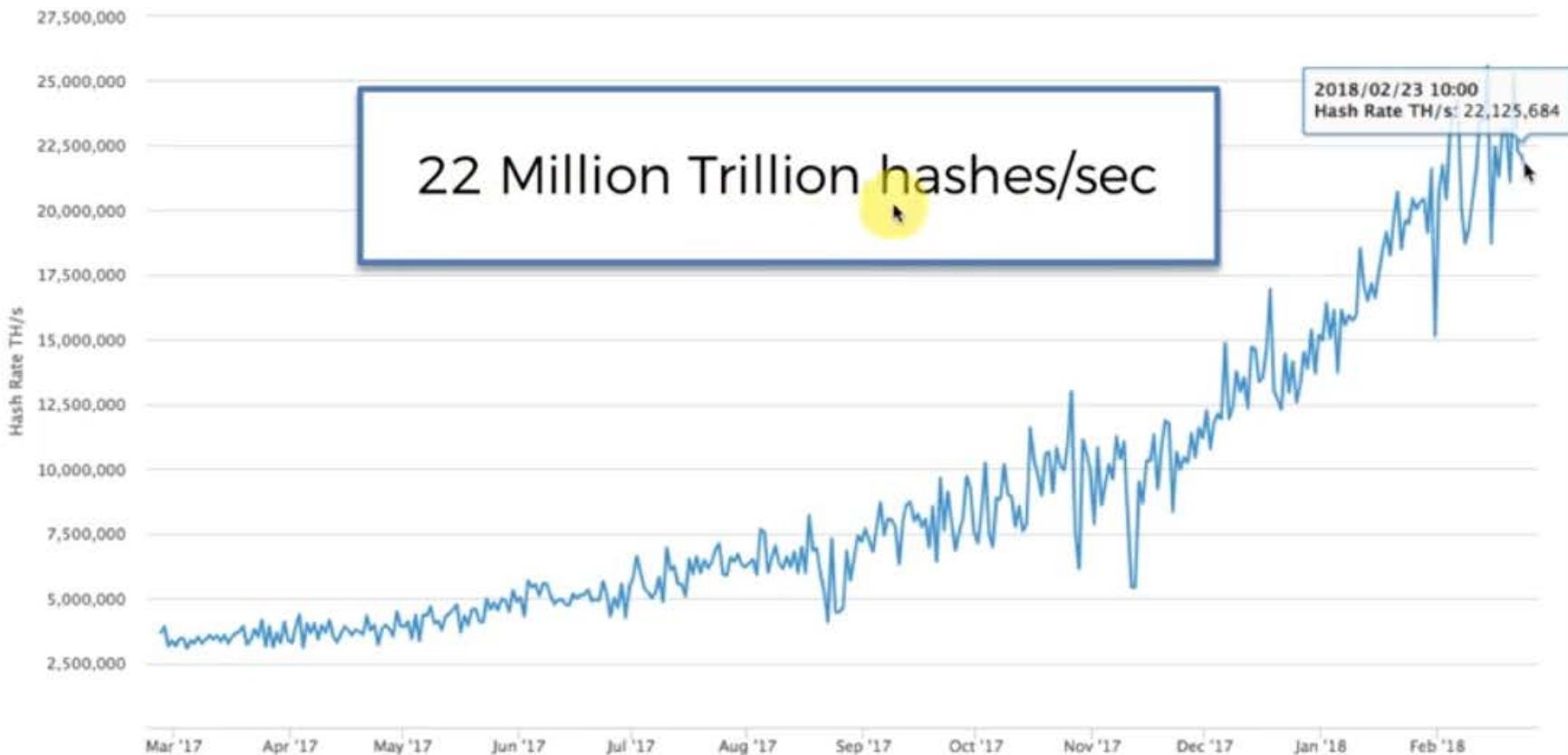


Nonce Range

Hash Rate

The estimated number of tera hashes per second (trillions of hashes per second) the Bitcoin network is performing.

Source: blockchain.info



How Miners Pick Transactions

How Miners Pick Transactions

MEMPOOL	
DF2E5A1	Fees: 0.00014 BTC
08A4197	Fees: 0.00003 BTC
4C7D0E5	Fees: 0.0004 BTC
AAC1888	Fees: 0.001 BTC
0BC09BF	Fees: 0.0002 BTC
85C19D7	Fees: 0.00023 BTC
08A4197	Fees: 0.0018 BTC
4C7D0E5	Fees: 0.0021 BTC
AAC1888	Fees: 0.00011 BTC
0BC09BF	Fees: 0.0001 BTC
85C19D7	Fees: 0.0017 BTC

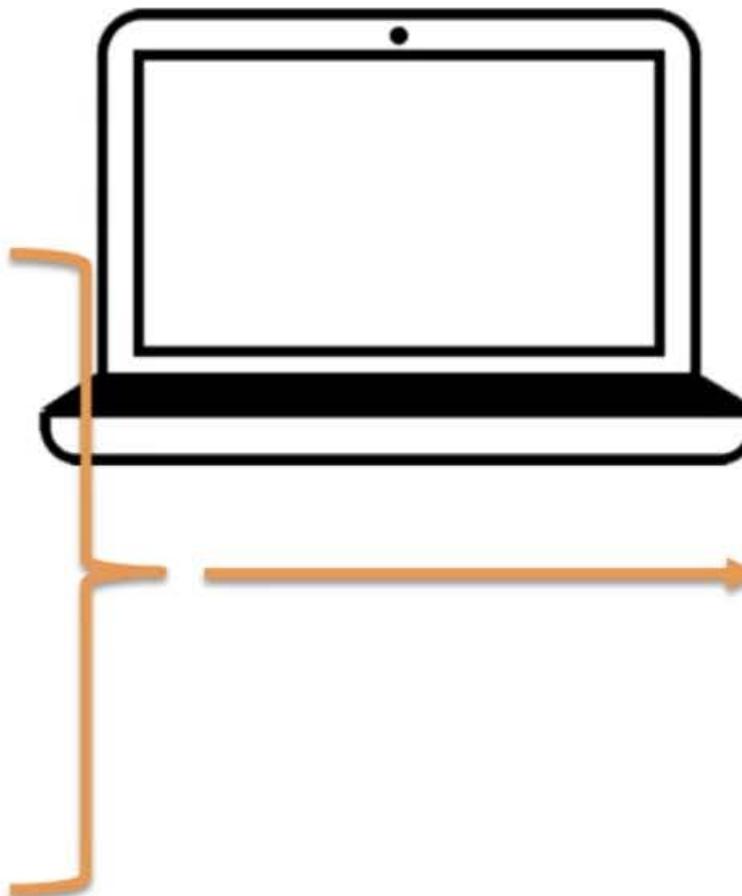


(Mining in Process)

Block: #500,112
Timestamp: 1519181244
Nonce:
Data:
Prev.Hash: 0000DF2E57FB432A
Hash:

How Miners Pick Transactions

MEMPOOL	
DF2E5A1	Fees: 0.00014 BTC
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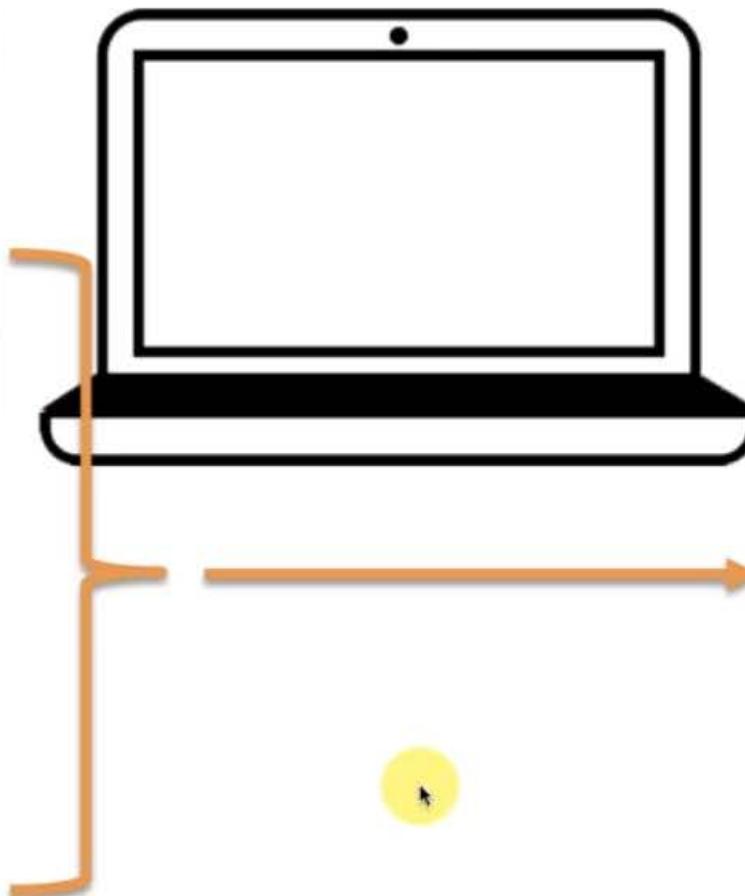


(Mining in Process)

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Timestamp: 1519181244
Nonce:
Data:
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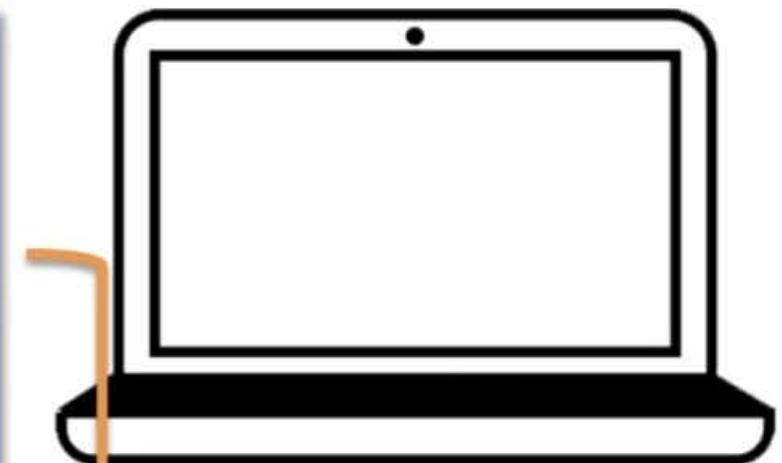


(Mining in Process)	
Block: #500,112	
Timestamp: 1519181244	
Nonce: 0	4 Billion
Data:	
4C7D0E5	Fees: 0.0004 BTC
AAC1888	Fees: 0.001 BTC
08A4197	Fees: 0.0018 BTC
4C7D0E5	Fees: 0.0021 BTC
85C19D7	Fees: 0.0017 BTC
Prev.Hash:	0000DF2E57FB432A
Hash:	

How Miners Pick Transactions

MEMPOOL

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AAC1888	Fees: 0.001 BTC
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08A4197	Fees: 0.0018 BTC
4C7D0E5	Fees: 0.0021 BTC
AAC1888	Fees: 0.00011 BTC
0BC09BF	Fees: 0.0001 BTC
85C19D7	Fees: 0.0017 BTC



Change Block Configuration

(Mining in Process)

Block: #500,112



Timestamp: 1519181244

Nonce: 0 4 Billion

Data:

4C7D0E5 Fees: 0.0004 BTC

AAC1888 Fees: 0.001 BTC

08A4197 Fees: 0.0018 BTC

4C7D0E5 Fees: 0.0021 BTC

85C19D7 Fees: 0.0017 BTC

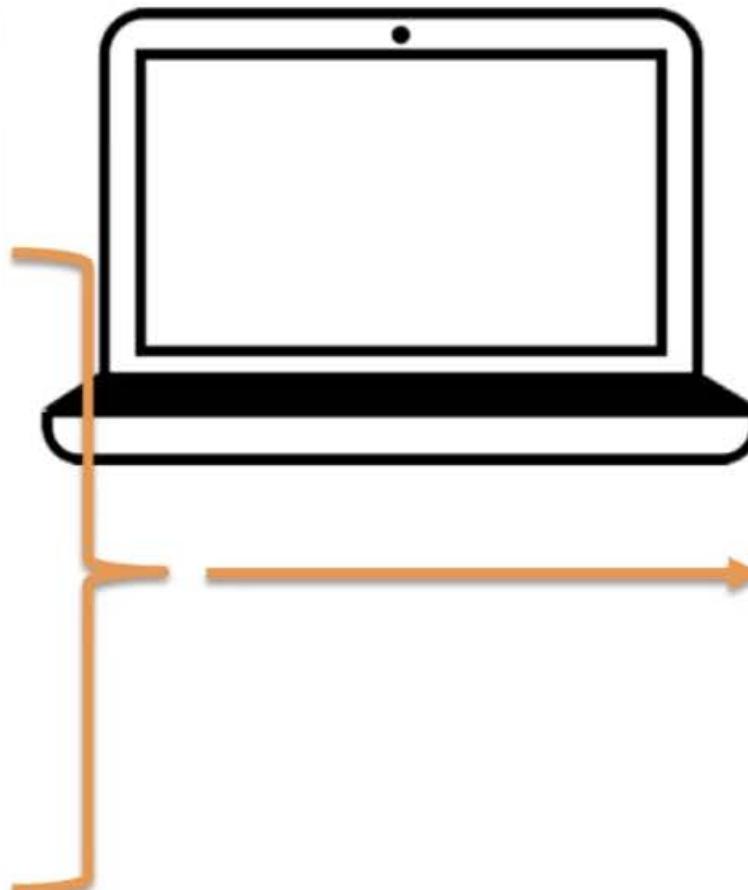
v.Hash: 0000DF2E57FB432A

sh:

How Miners Pick Transactions

MEMPOOL

DF2E5A1	Fees: 0.00014 BTC
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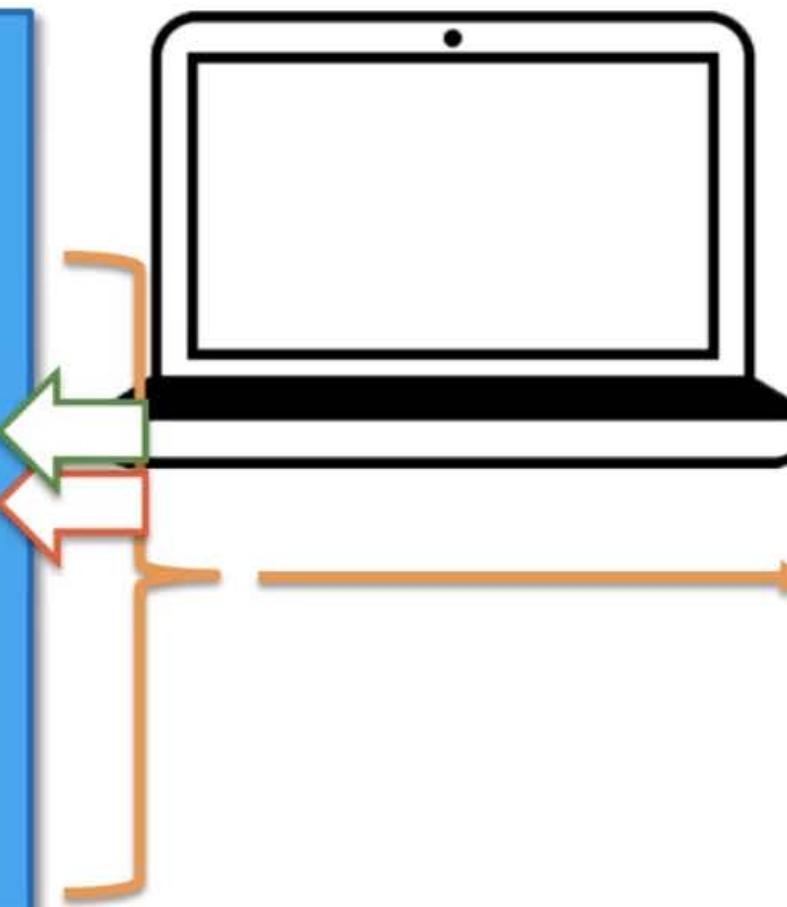


(Mining in Process)

Block: #500,112	
Timestamp: 1519181244	
Nonce: 0	4 Billion
Data:	
85C19D7	Fees: 0.00023 BTC
AAC1888	Fees: 0.001 BTC
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85C19D7	Fees: 0.0017 BTC
Prev.Hash:	0000DF2E57FB432A
Hash:	

How Miners Pick Transactions

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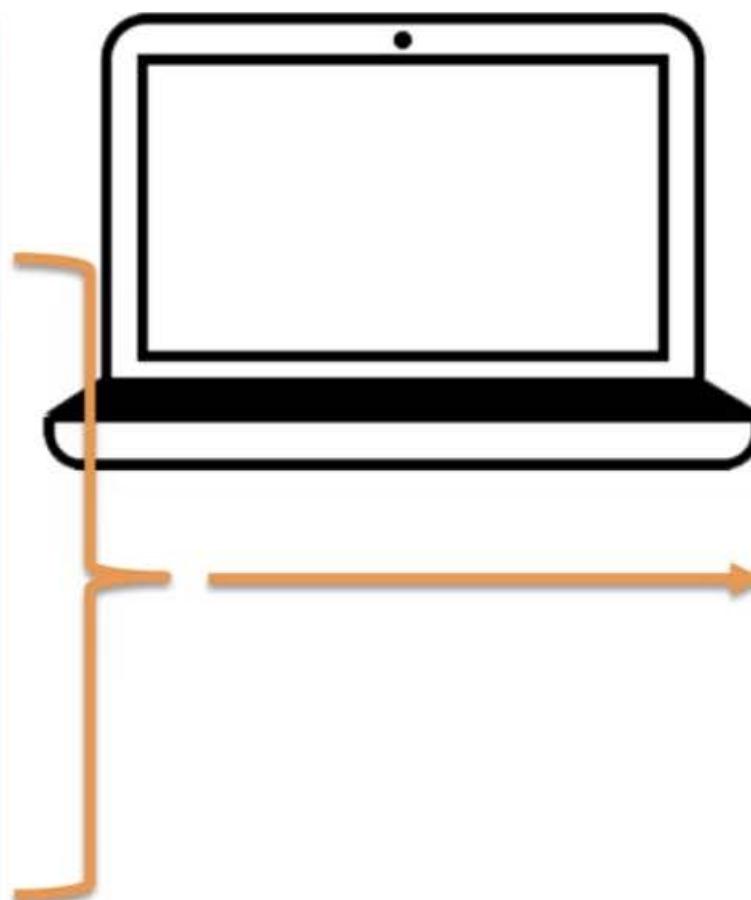


(Mining in Process)

Block: #500,112	 <1s
Timestamp: 1519181244	
Nonce: 0	4 Billion
Data:	
AAC1888	Fees: 0.001 BTC
08A4197	Fees: 0.0018 BTC
4C7D0E5	Fees: 0.0021 BTC
85C19D7	Fees: 0.0017 BTC
Prev.Hash:	0000DF2E57FB432A
Hash:	

How Miners Pick Transactions

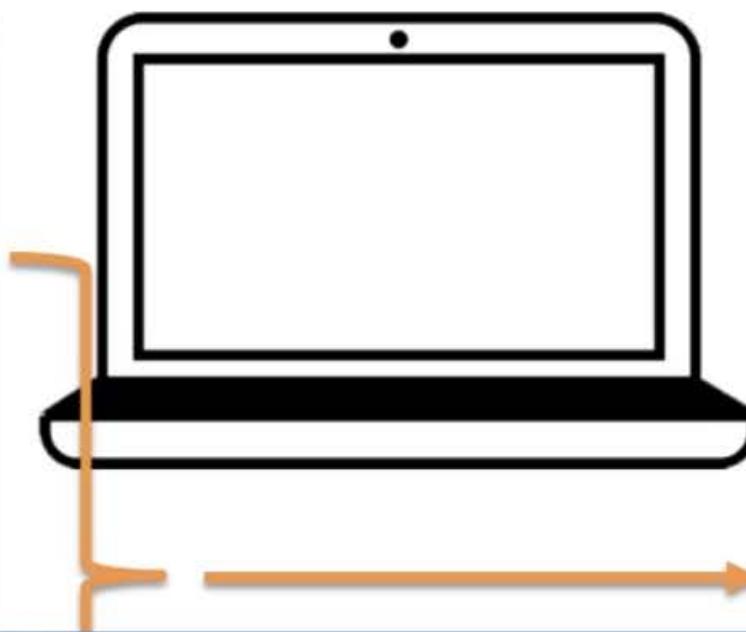
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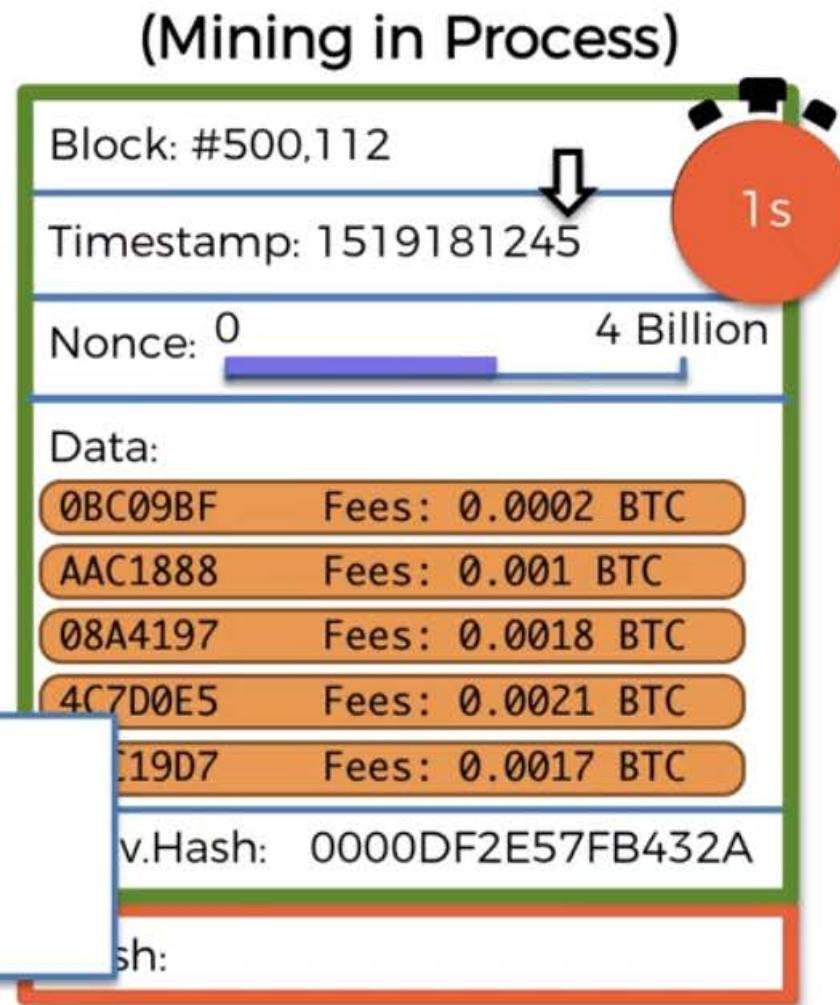
(Mining in Process)	
Block: #500,112	1s
Timestamp: 1519181244	
Nonce: 0	4 Billion
Data:	
0BC09BF	Fees: 0.0002 BTC
AAC1888	Fees: 0.001 BTC
08A4197	Fees: 0.0018 BTC
4C7D0E5	Fees: 0.0021 BTC
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How Miners Pick Transactions

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85C19D7	Fees: 0.0017 BTC



Start Over



CPUs vs GPUs vs ASICs

CPU = Central Processing Unit

General

< 10 MH/s

GPU = Graphics Processing Unit

Specialized

< 1 GH/s

ASIC = Application-Specific Integrated Circuit

Totally Specialized

> 1,000 GH/s

Cloud Mining

Secure | https://www.ebay.com/itm/Shark-Zcash-Ethereum-Bitcoin-Mining-Rig-4500H-s-200MH-s-6-GPU-GTX1080Ti-Crypto/161737078561?hash=item25a847f721

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Shark Zcash Ethereum Bitcoin Mining Rig 4500H/s 200MH/s 6 GPU GTX1080Ti Crypto
Ethereum, Siacoin, Zclassic, Hush, Nicetash, Pascalcain
1 viewed per hour

Condition: -- "All New components. ZCASH ETH Mining Rig 4500 H/S 6 X NVIDIA GTX 1080 Ti 11GB GPU Cryptocurrency" ... Read more

Quantity: 1 3 available / 9 sold

Price: US \$17,000.00 Buy It Now Add to cart

Best Offer: Make Offer
Add to watch list Add to collection

Limited quantity remaining More than 74% sold Longtime member

Shipping: May not ship to Australia - Read item description or contact seller for shipping options. | See details
Item location: Sunnyvale, California, United States
Ships to: United States | See exclusions

Delivery: Varies
Payments: PayPal | See details

Returns: Seller does not accept returns | See details
Guarantee: ebay MONEY BACK GUARANTEE | See details
Get the item you ordered or get your money back.
Covers your purchase price and original shipping.

Seller information
bizon_computers (795 ★)
97.7% Positive feedback

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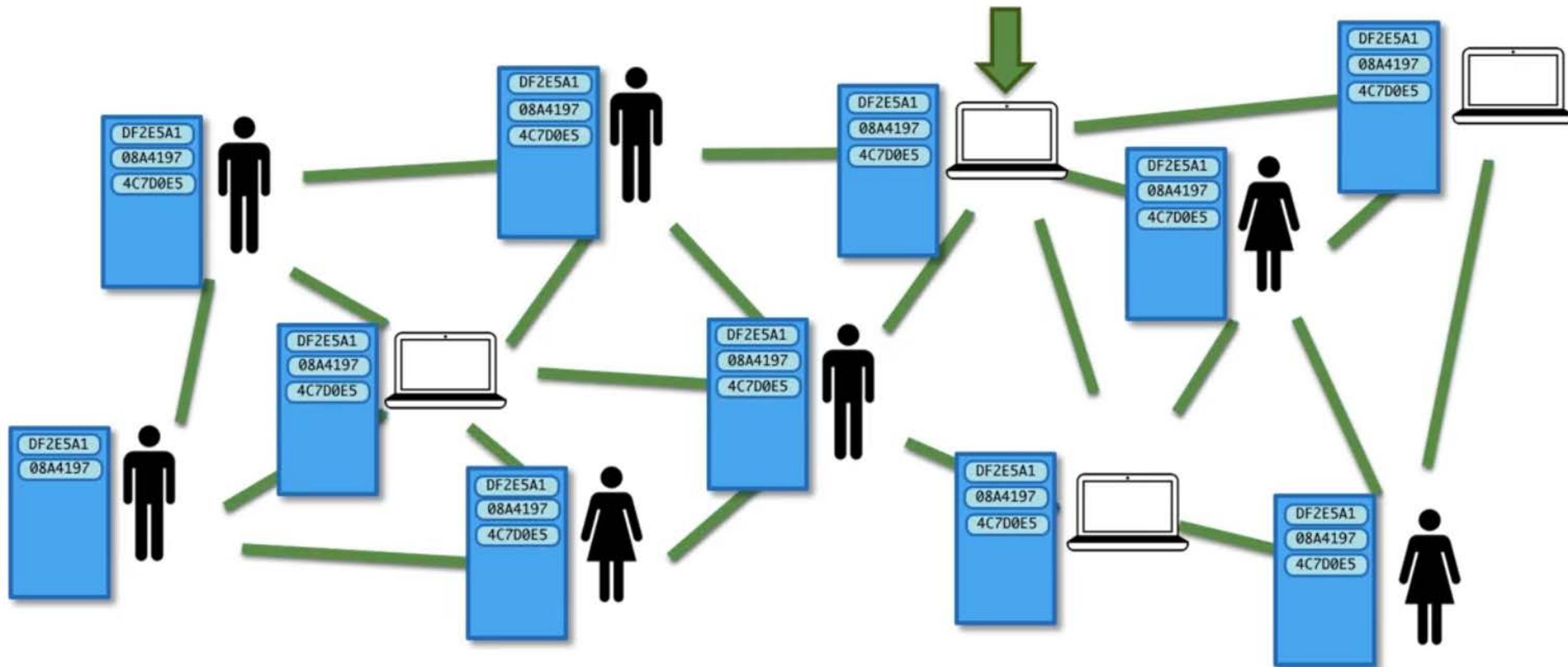
\$ Have one to sell? Sell now

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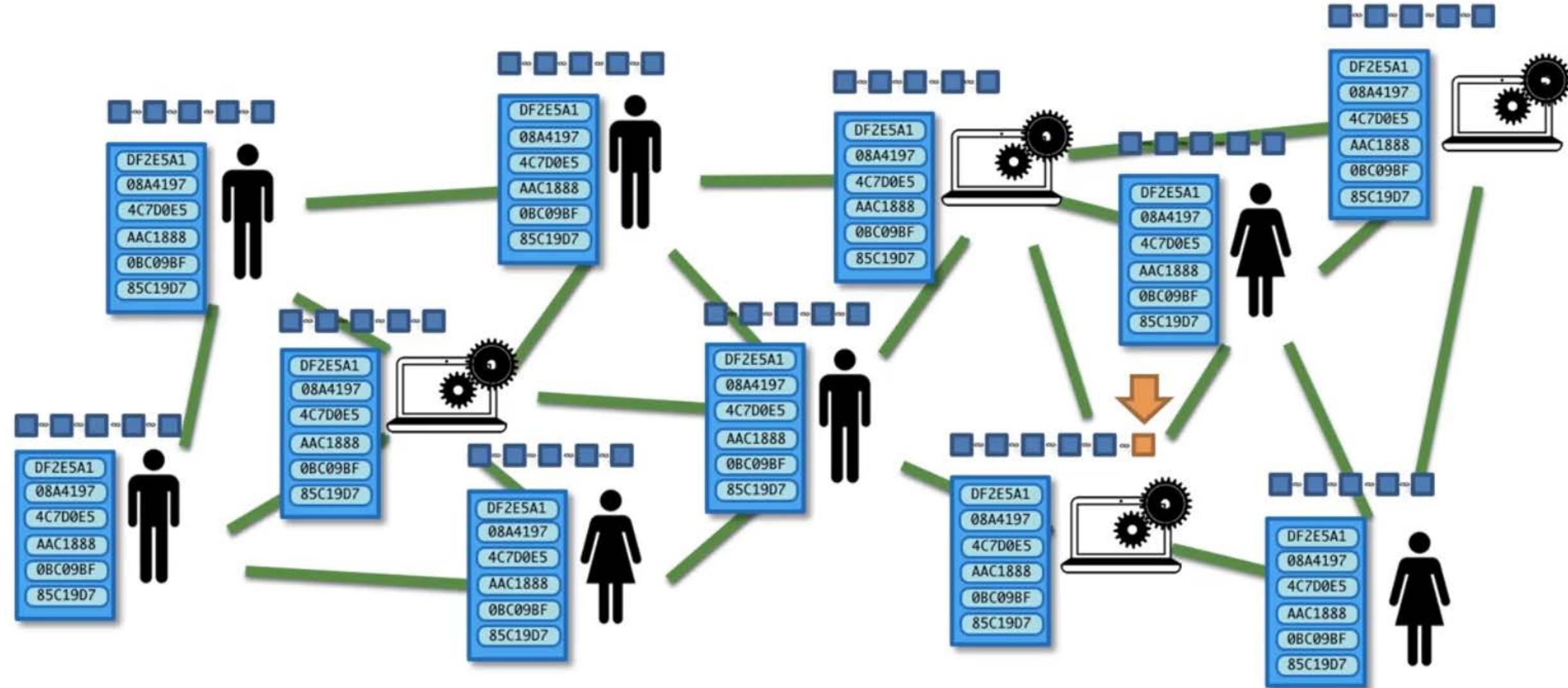
Feedback on our suggestions

Full mining & controlled airflow kit
All parts included except the GPU cards

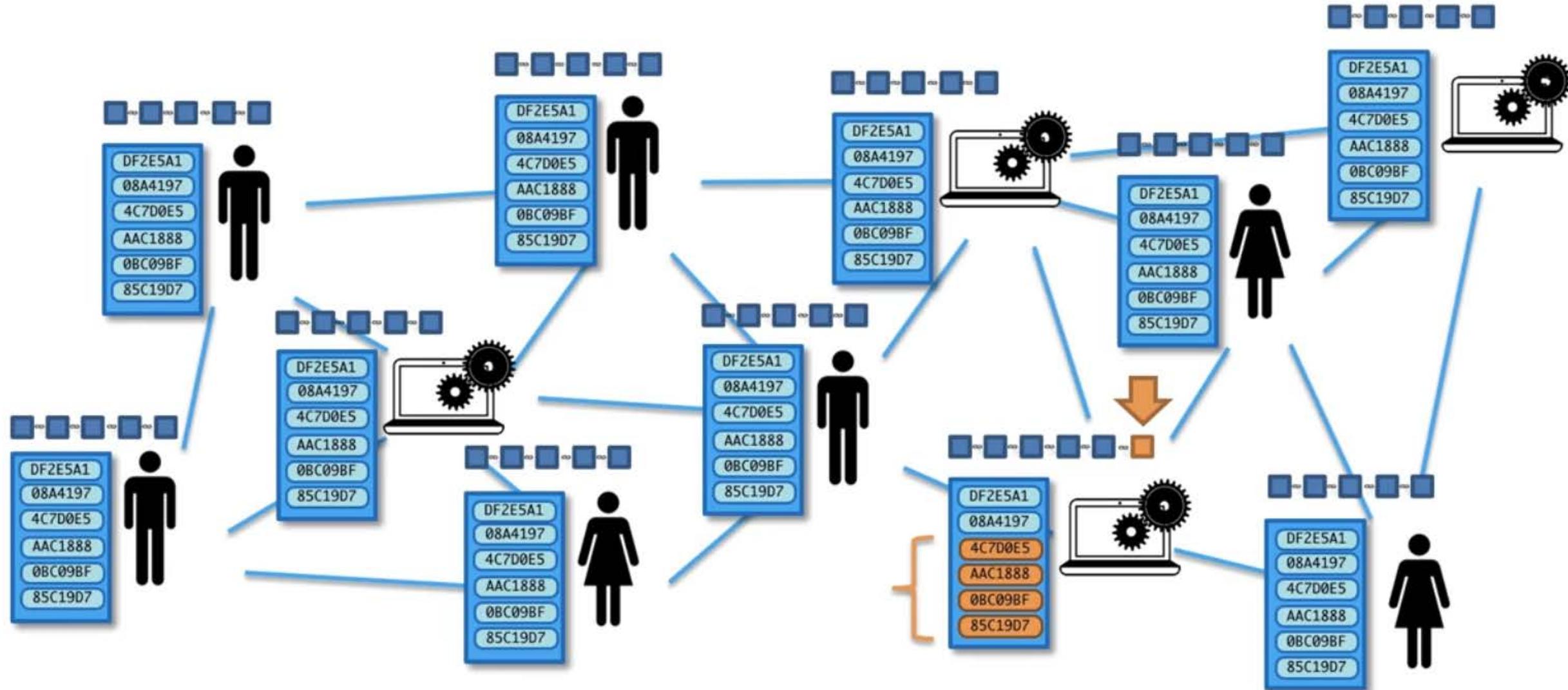
How do Mempools work?



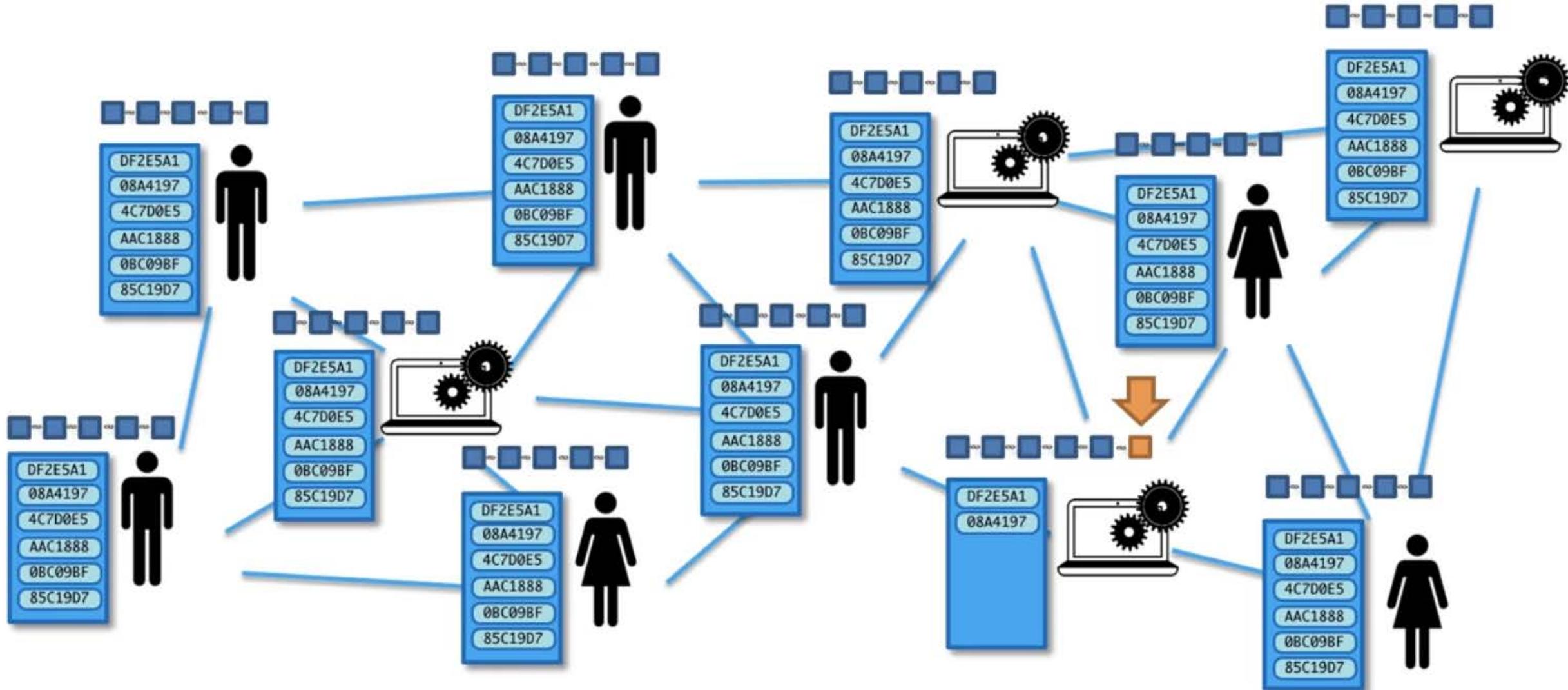
How do Mempools work?



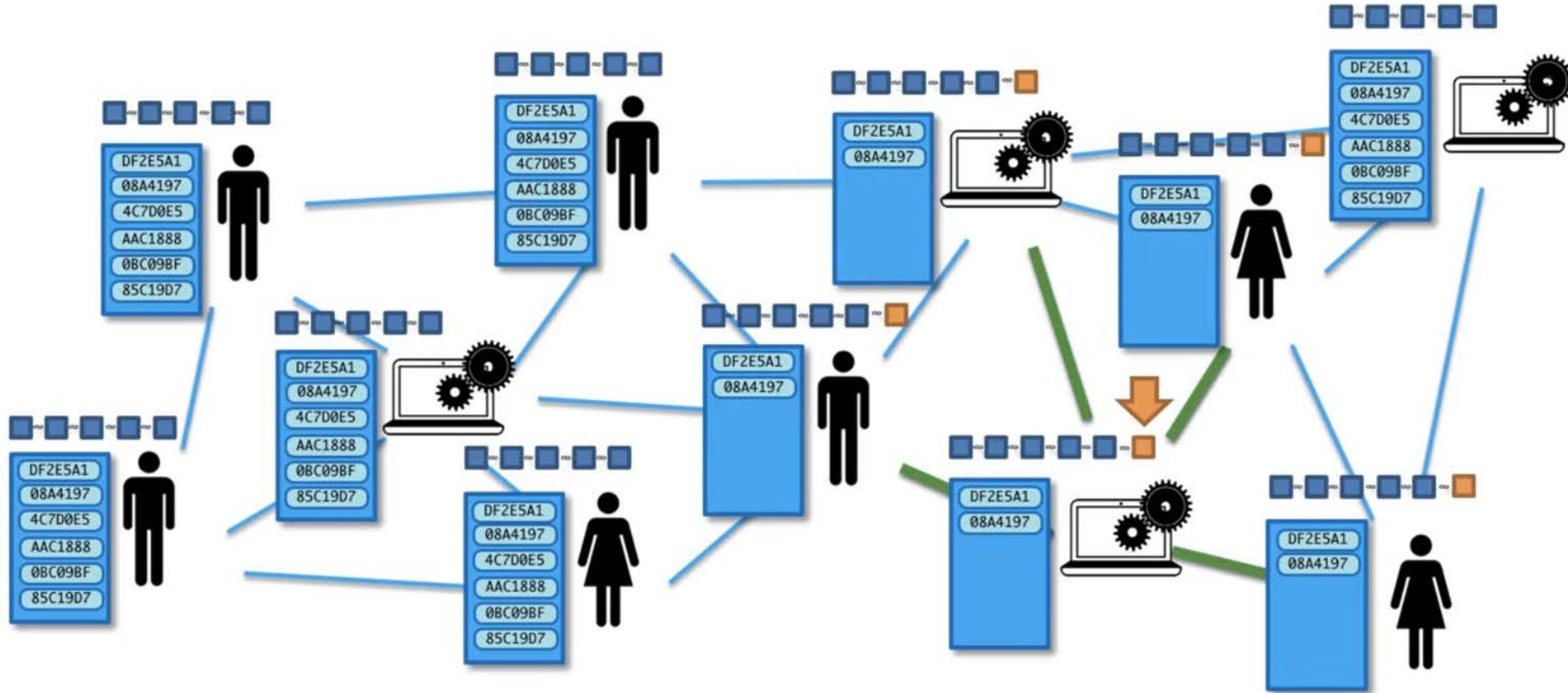
How do Mempools work?



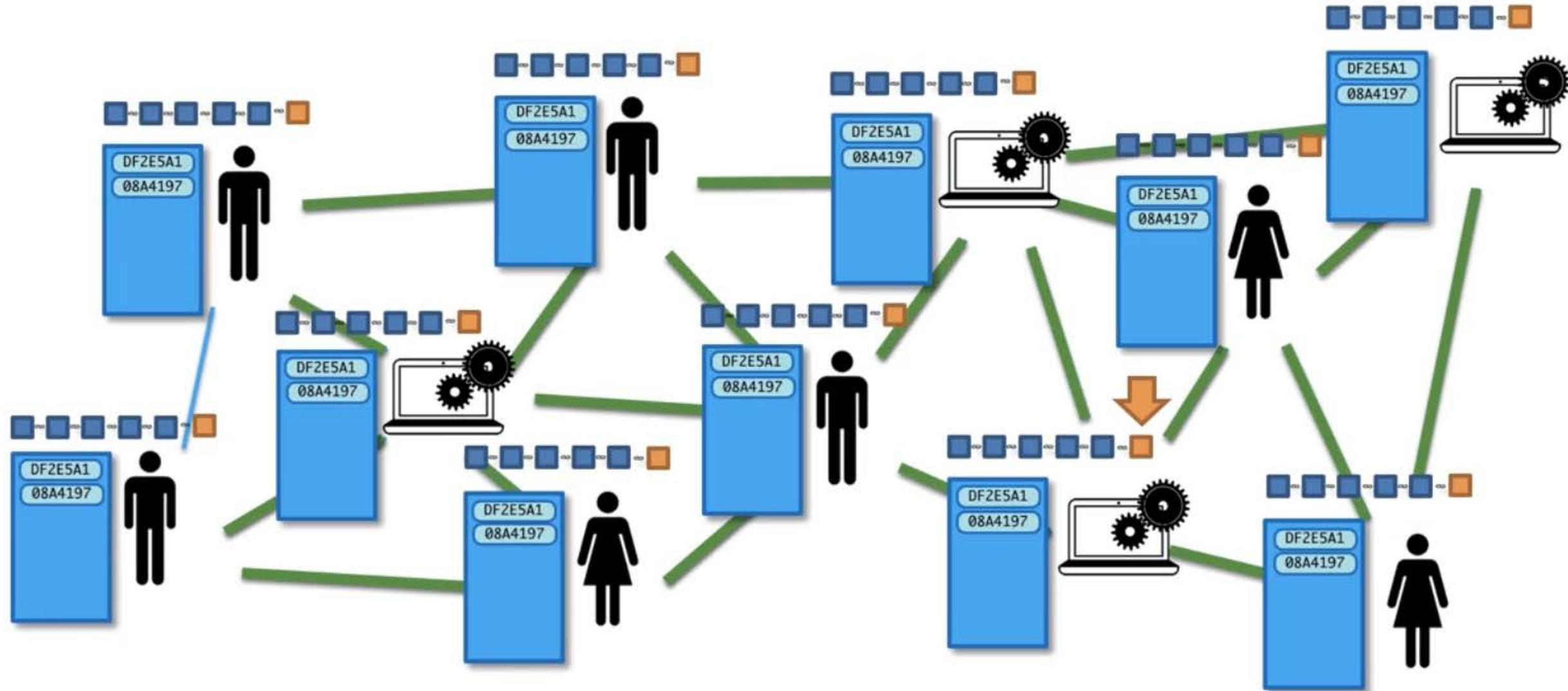
How do Mempools work?



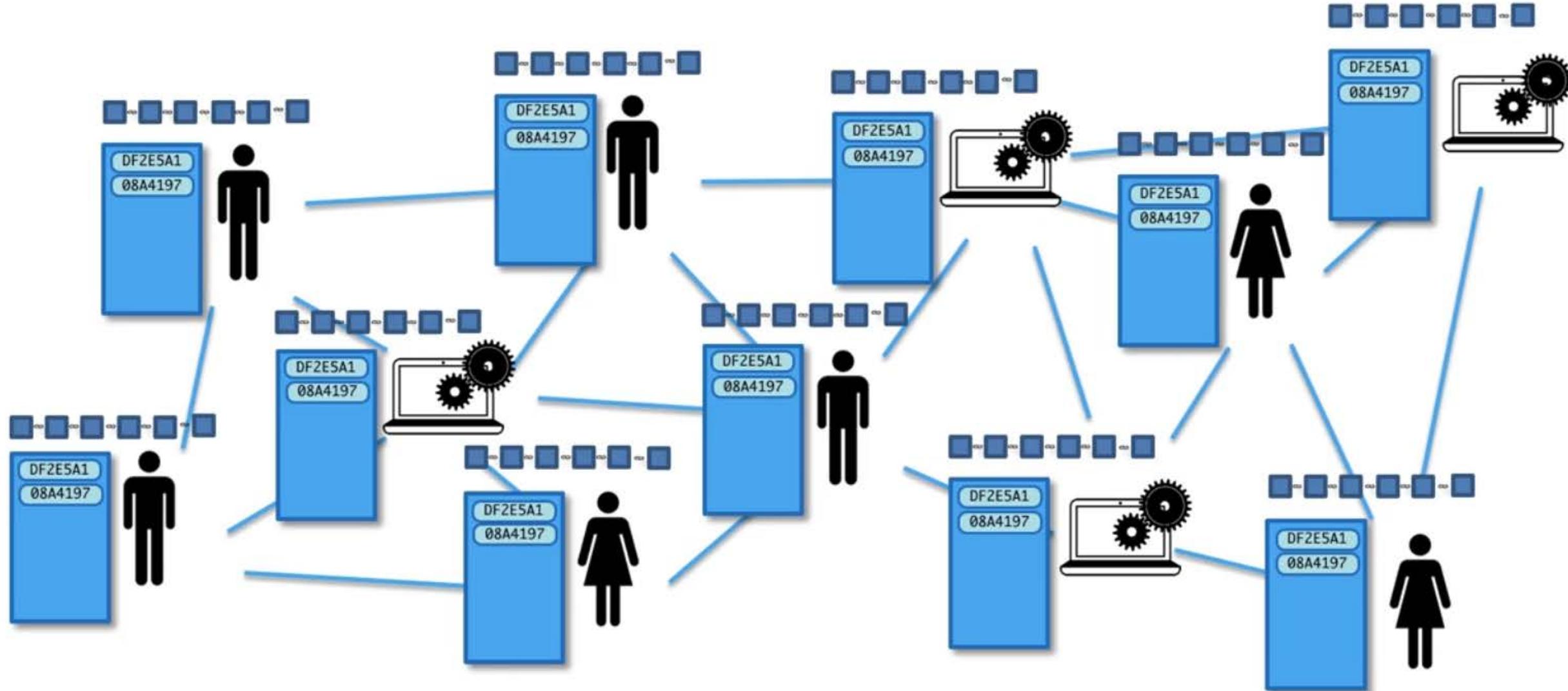
How do Mempools work?



How do Mempools work?



How do MemPools work?



8804 Unconfirmed Transactions

Live updating list of new bitcoin transactions



Summary

Status: Connected

Total Fees

67.95860408 BTC

Total Size

286369.654 (KB)

Transactions Per Second

10.8



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Start
Trading

4b25c617a78f2900c928f1f586309fe1805029c59a7ba7ba1941544a995b64b

Today 21:27:22

bc1q4xc3u8y9rmv0ypy9zt6(2atpjlyqszm3404w)



bc1qsgceikhpz8ha5hhkk6hdj30nu5762fanyz7x

0.59861521 BTC

6d36141c25dec44ce378f4a75d2ff9cd8b5272fb273567c205ecc54d0f05bdb

Today 21:27:22

19tLJQmSzJMmMyicwJh4rXchrsNsh4FWo6



1Co4woivDguqQ1dtZKhXMhNhVGsejCoQhA

0.0015686 BTC

c942e8655e5ec65a4158e3e09412737cadc91649060b2aa115bf4ee6b5e7ab3

Today 21:27:22

bc1qq868d2pr4rykgasuctdavc494xznnuukwummm4l



1BrrnLesFfa9J2ZqGwhJHsht8tjk0YokLIP

0.16852595 BTC

2da2d0f0e78ff71d248e812388f70cd2f605c2927e0e08cfccda3d3902b382

Today 21:27:22

bc1qwifflmv9cwyc88nqcsxit3syn5fw7vvvadj5x



bc1qmsw59cq3sjg30czjac8xwwmidt2e422mjzawe

0.13391999 BTC

4a08cad8042ccb622040726b4355cc50d0ac294e1384f1ea09fb213b3186b3ab

Today 21:27:22

Bitcoin Stats

Blockchain Luxembourg S.A.R.L [LU] | https://blockchain.info/stats

BLOCKCHAIN

WALLET DATA API ABOUT

Q BLOCK, HASH, TRANSACTION, ETC...

Total Miners Revenue (USD)	\$21,306,754.51	View Chart
% Earned From Transaction Fees	2.51%	
% Of Transaction Volume	1.62%	View Chart
Cost per Transaction (USD)	\$102.64	View Chart

HASH RATE AND ELECTRICITY CONSUMPTION

Difficulty	3,007,383,866,429	View Chart
Hash Rate	23,172,168,746 GH/s	View Chart

OTHER BITCOIN LINKS

[Most Popular Addresses](#) - Addresses which have received the most payments
[Orphaned Blocks](#) - Valid blocks not part of the main bitcoin chain
[Unconfirmed Transactions](#) - Transactions waiting to be included in a block
[Largest Transactions](#) - Largest 50 transactions
[Double Spends](#) - Double spends detected in the last 500,000 transactions
[Strange Transactions](#) - Unable to decode the output

[Mining Pool Stats](#) - Pie chart showing the market share of the top bitcoin mining pools
[Rejected Inventory](#) - Blocks and transactions which have been rejected by our nodes
[Address Tags](#) - Tag your public bitcoin addresses.
[My Wallet](#) - Manage your money with Bitcoin's most advanced web wallet.



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Orphaned Blocks - Blockchain

Blockchain Luxembourg S.A.R.L [LU] | https://blockchain.info/orphaned-blocks

BLOCKCHAIN WALLET DATA API ABOUT

SEARCH BLOCK, HASH, TRANSACTION, ETC...

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Orphaned Blocks

Detached or Orphaned blocks are valid blocks which are not part of the main chain. They can occur naturally when two miners produce blocks at similar times or they can be caused by an attacker (with enough hashing power) attempting to reverse transactions.

Next Page >>

	↑		✗	
	Timestamp	2018-01-12 23:28:07	Timestamp	2018-01-12 23:28:33
503949	Number Of Transactions	2991	Number Of Transactions	2874
	Relayed By	GBMiners	Relayed By	SlushPool

	↑ ↗		✗	
	Timestamp	2018-01-12 23:10:32		
503948	Number Of Transactions	1766		
	Relayed By	BTC.com		

	↑		✗	
	Timestamp	2017-12-06 06:45:56	Timestamp	2017-12-06 06:46:32
497871	Number Of Transactions	2437	Number Of Transactions	2446
	Relayed By	Unknown	Relayed By	SlushPool



Orphaned Blocks

Detached or Orphaned blocks are valid blocks which are not part of the main chain. They can occur naturally when two miners produce blocks at similar times or they can be caused by an attacker (with enough hashing power) attempting to reverse transactions.

[Next Page >>](#)

				
	Timestamp	2018-01-12 23:26:07	Timestamp	2018-01-12 23:26:33
503949	Number Of Transactions	2991	Number Of Transactions	2874
	Relayed By	GBMiners	Relayed By	SlushPool



			
	Timestamp	2018-01-12 23:10:32	
503948	Number Of Transactions	1766	
	Relayed By	BTC.com	



				
	Timestamp	2017-12-06 06:45:56	Timestamp	2017-12-06 06:46:32
497871	Number Of Transactions	2437	Number Of Transactions	2446
	Relayed By	Unknown	Relayed By	SlushPool

494676	Number Of Transactions	2114	Number Of Transactions	2098
	Relayed By	58COIN	Relayed By	BTC.com



Timestamp 2017-11-16
21:42:56

494675	Number Of Transactions	2155
	Relayed By	AntPool



Timestamp 2017-10-13
15:26:34

Timestamp 2017-10-13
15:26:37

489644	Number Of Transactions	1944	Number Of Transactions	2624
	Relayed By	ViaBTC	Relayed By	Bixin



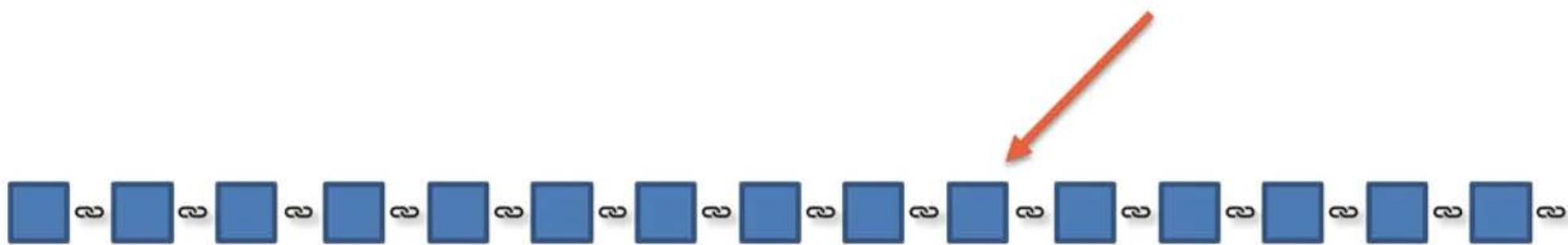
Timestamp 2017-10-13
15:05:18

489643	Number Of Transactions	2073
	Relayed By	SlushPool



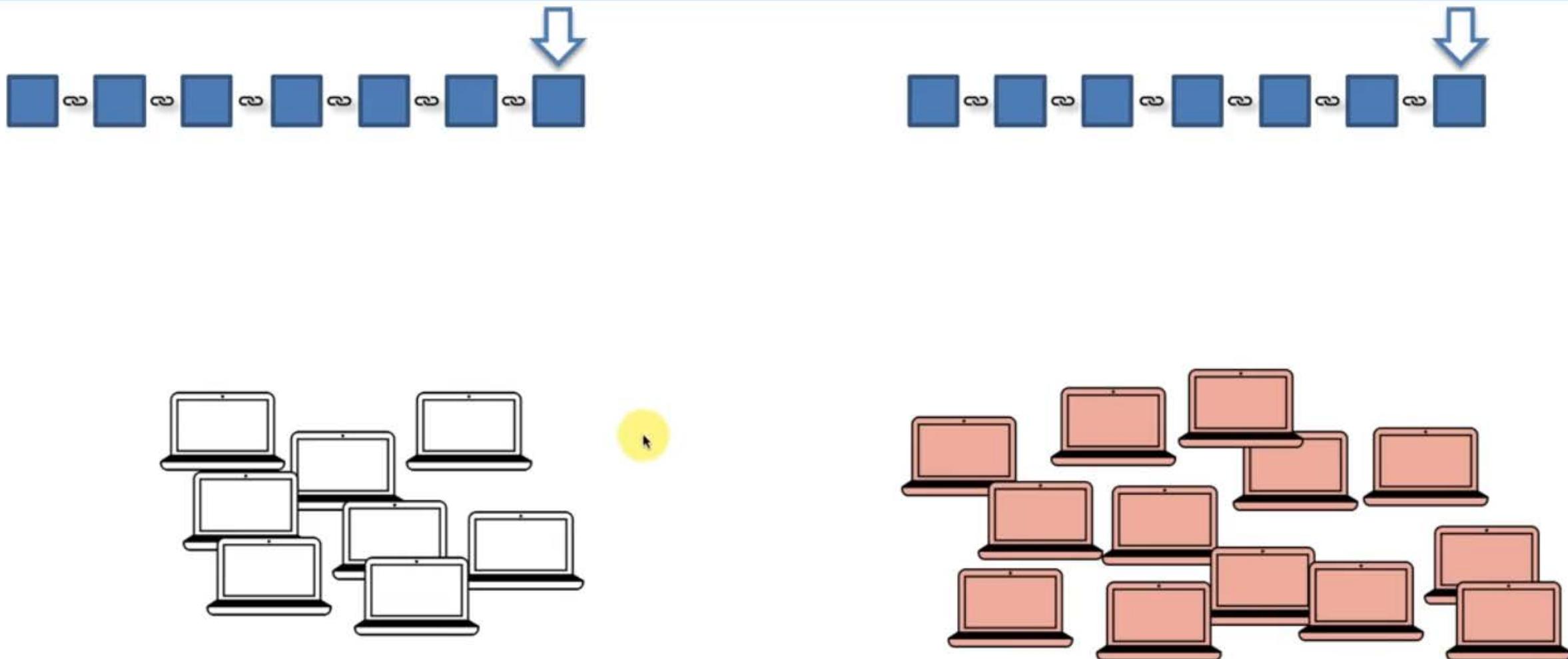
The 51% Attack

The 51% Attack

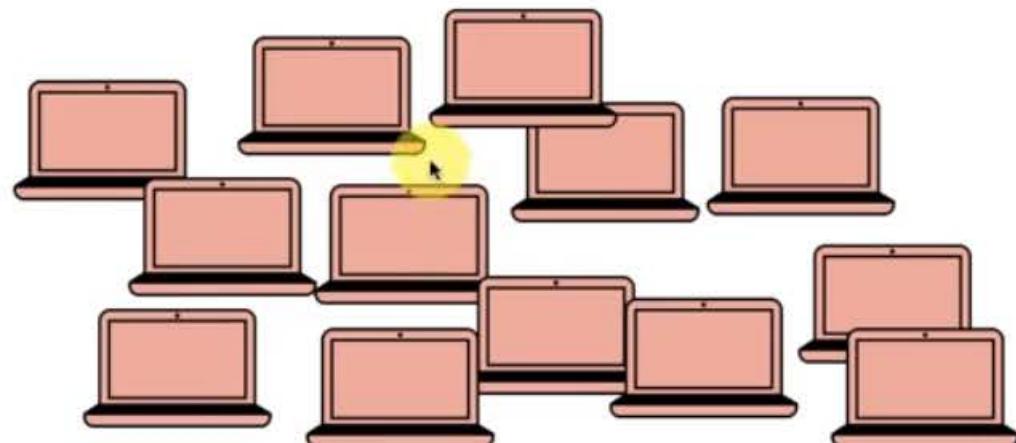
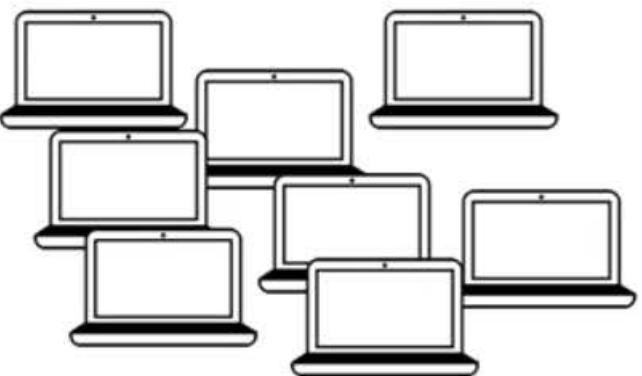
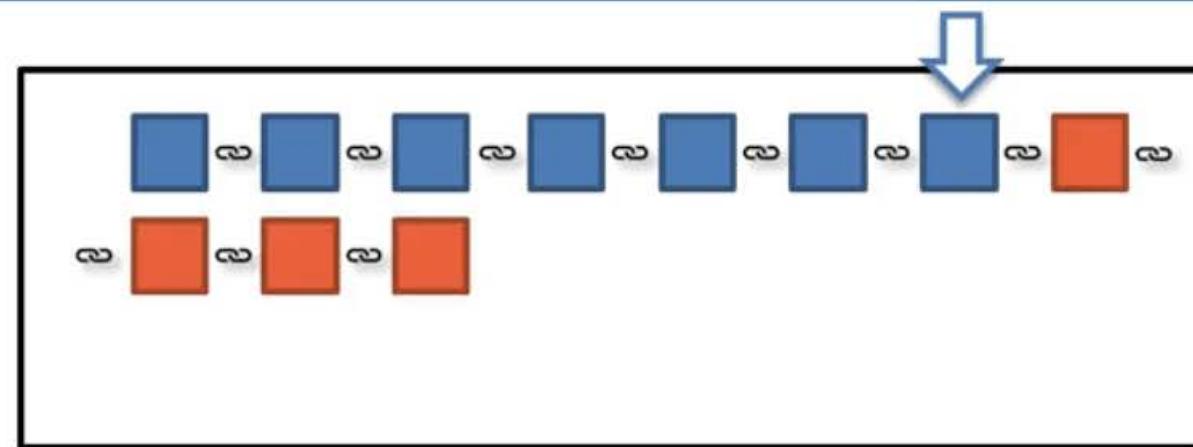
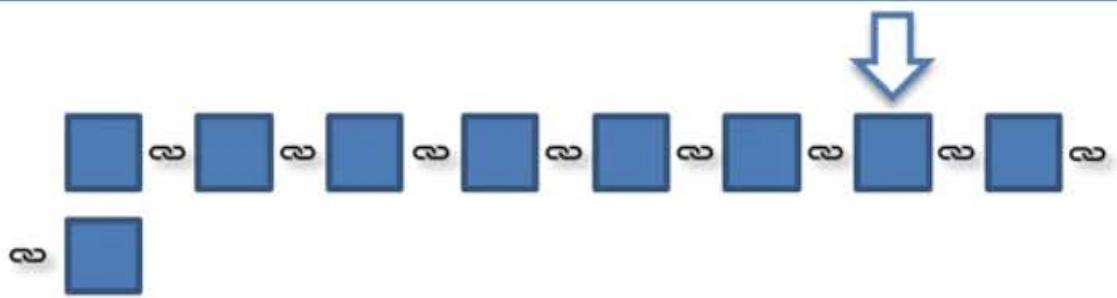


This is NOT the 51% attack

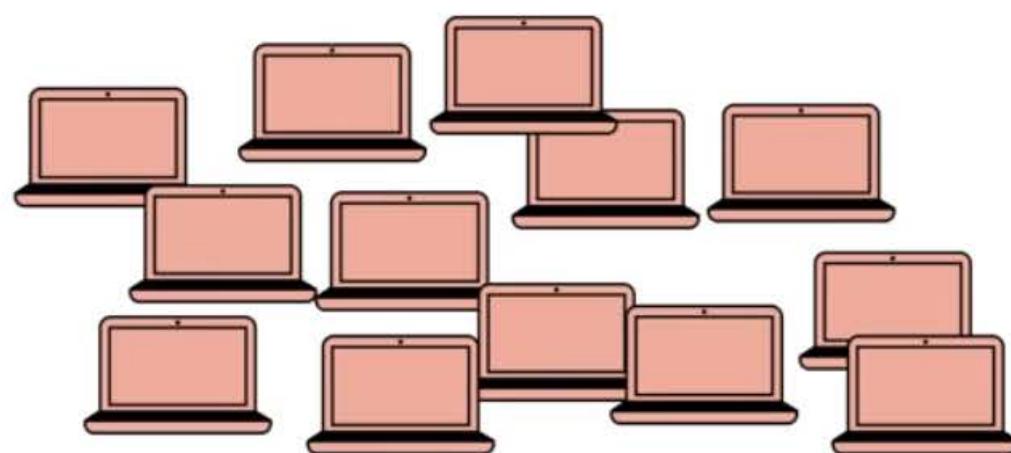
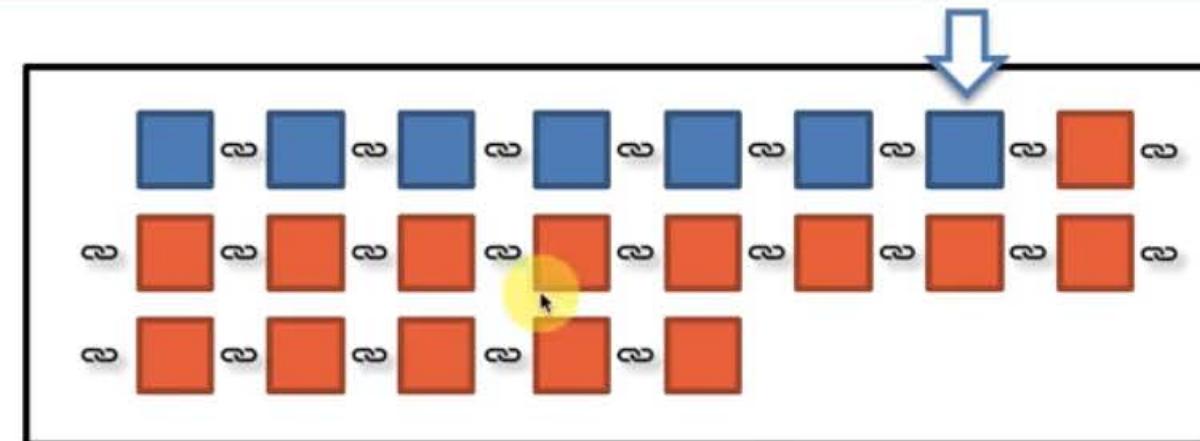
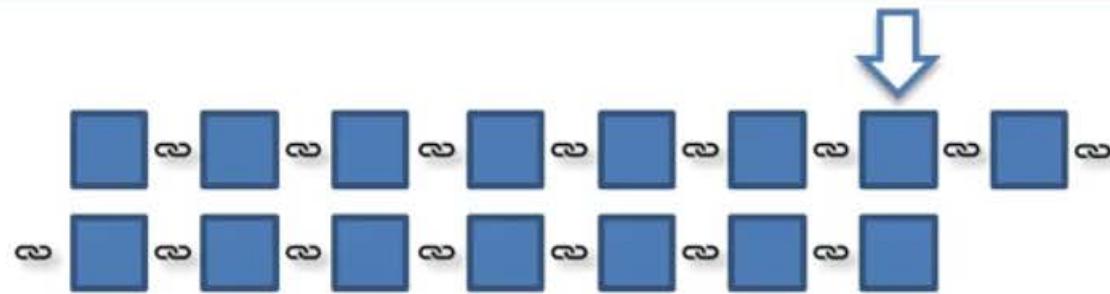
The 51% Attack



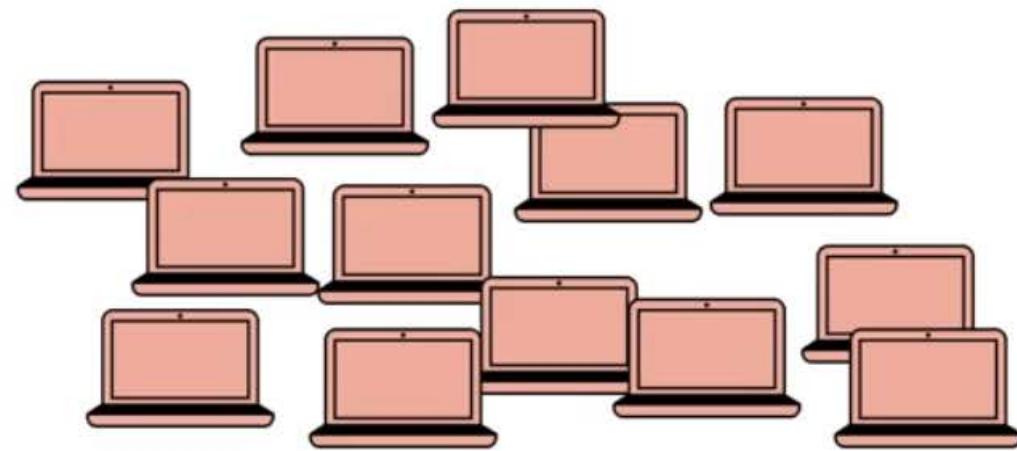
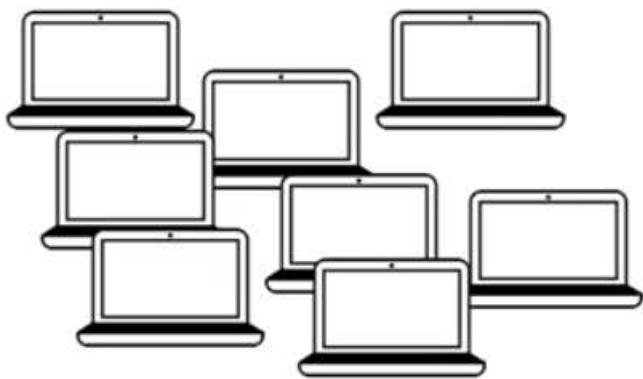
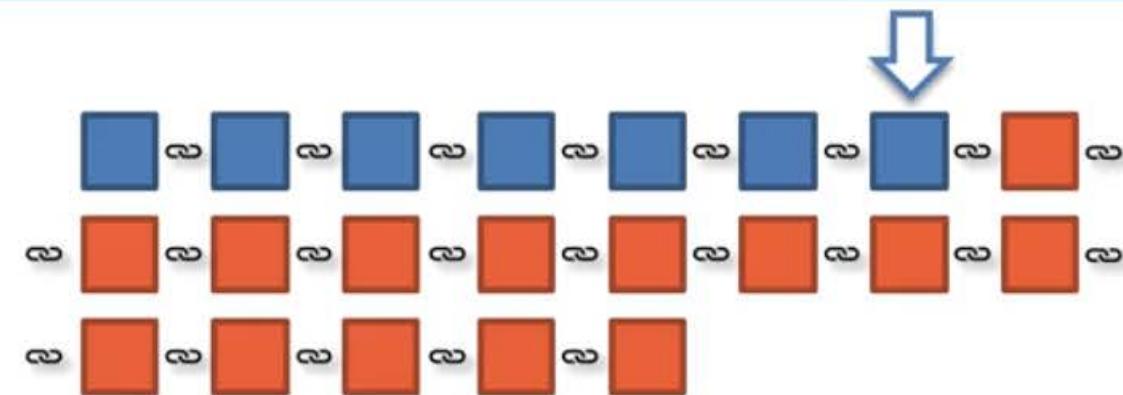
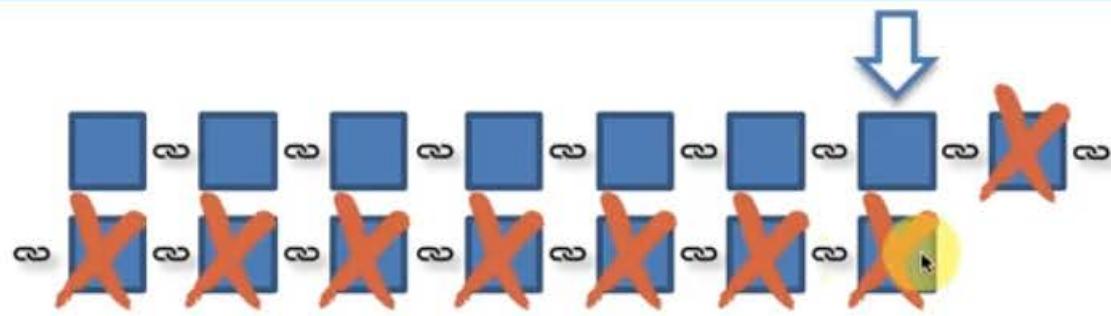
The 51% Attack



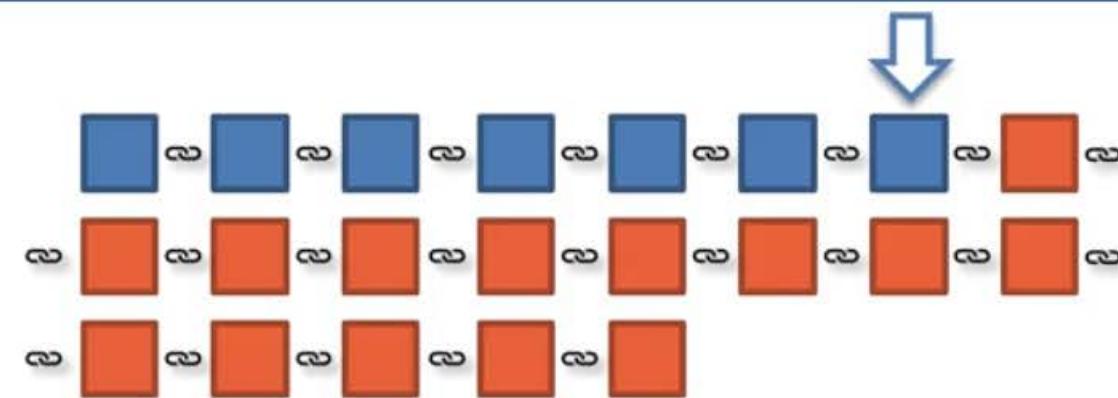
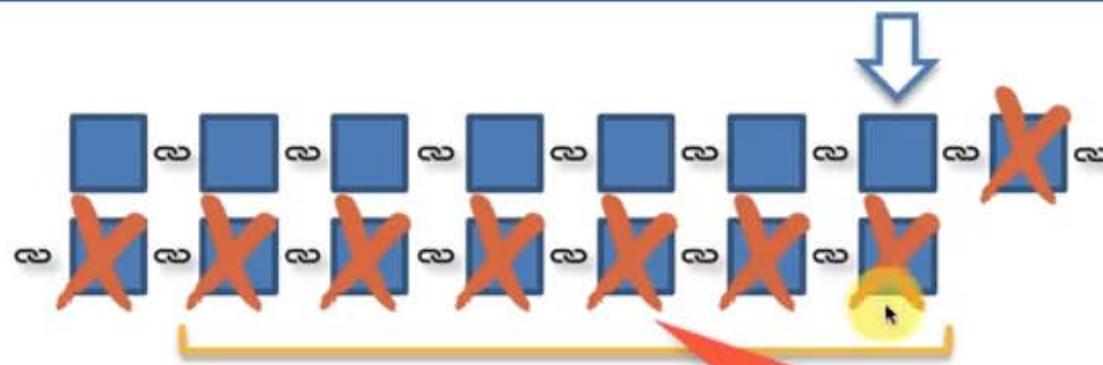
The 51% Attack



The 51% Attack



The 51% Attack



My mistake.
Actually it's 3 confirmations -
because that block itself is
included in the count.

EXTRA:

Deriving the current target

Deriving the current target

Difficulty = current target / max target

Curr target = 000000000000000000005d97dc00000000000000000000

Where is the current target stored?

Block #510808

Summary	
Number Of Transactions	329
Output Total	2,093.19925201 BTC
Estimated Transaction Volume	138.61944625 BTC
Transaction Fees	0.06499889 BTC
Height	510808 (Main Chain)
Timestamp	2018-02-25 06:48:56
Received Time	2018-02-25 06:48:56
Relayed By	ViaBTC
Difficulty	3,007,383,866,429.73
Bits	392009692
Size	1006.782 kB
Weight	3978.903 kWU
Version	0x20000000
Nonce	1936277748
Block Reward	12.5 BTC

R Decimal to Hex converter | https://www.rapidtables.com/convert/number/decimal-to-hex.html

Secure | https://www.rapidtables.com/convert/number/decimal-to-hex.html

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SQUARESPACE START A WEBSITE

Decimal to Hex converter

Enter decimal number:
392009692

Convert Reset Swap

Hex number:
175D97DC

Hex signed 2's complement:
175D97DC

Binary number:
10111010111011001011111011100

Hex to decimal converter ►

How to convert from decimal to hex

Conversion steps:

1. Divide the number by 16.
2. Get the integer quotient for the next iteration.
3. Get the remainder for the hex digit.
4. Repeat the steps until the quotient is equal to 0.

Example #1

Convert 7562_{10} to hex:

Division by 16	Quotient	Remainder (decimal)	Remainder (hex)	Digit #
----------------	----------	---------------------	-----------------	---------

Windows 10 Pro means business.

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NUMBER CONVERSION

Deriving the current target

Difficulty = current target / max target

Where is the current target stored?

Bits -> Hex -> Derive target

Bits: 392009692

Bits in Hex: 175D97DC

$$16^*1+7 = 23$$

Deriving the current target

Difficulty = current target / max target

Where is the current target stored?

Bits -> Hex -> Derive target

Bits: 392009692

Bits in Hex: 175D97DC

$$16^*1+7$$

= 23



$$\begin{aligned}23 \text{ bytes} &= 23 \times 8 \text{ bits} \\&= 23 \times 2 \times 4 \text{ bits} \\&= 23 \times 2 \times \text{Hex Digits}\end{aligned}$$

$23 \times 2 = 46$ Hex Digits

Deriving the current target

Difficulty = current target / max target

Where is the current target stored?

Bits -> Hex -> Derive target

Bits: 392009692

Bits in Hex: 175D97DC

$$\begin{array}{r} 16^{\ast}1+7 \\ = 23 \end{array}$$

$23 \times 2 = 46$ Hex Digits

Deriving the current target

Difficulty = current target / max target

Where is the current target stored?

Bits -> Hex -> Derive target

Bits: 392009692

Bits in Hex: 175D97DC

