

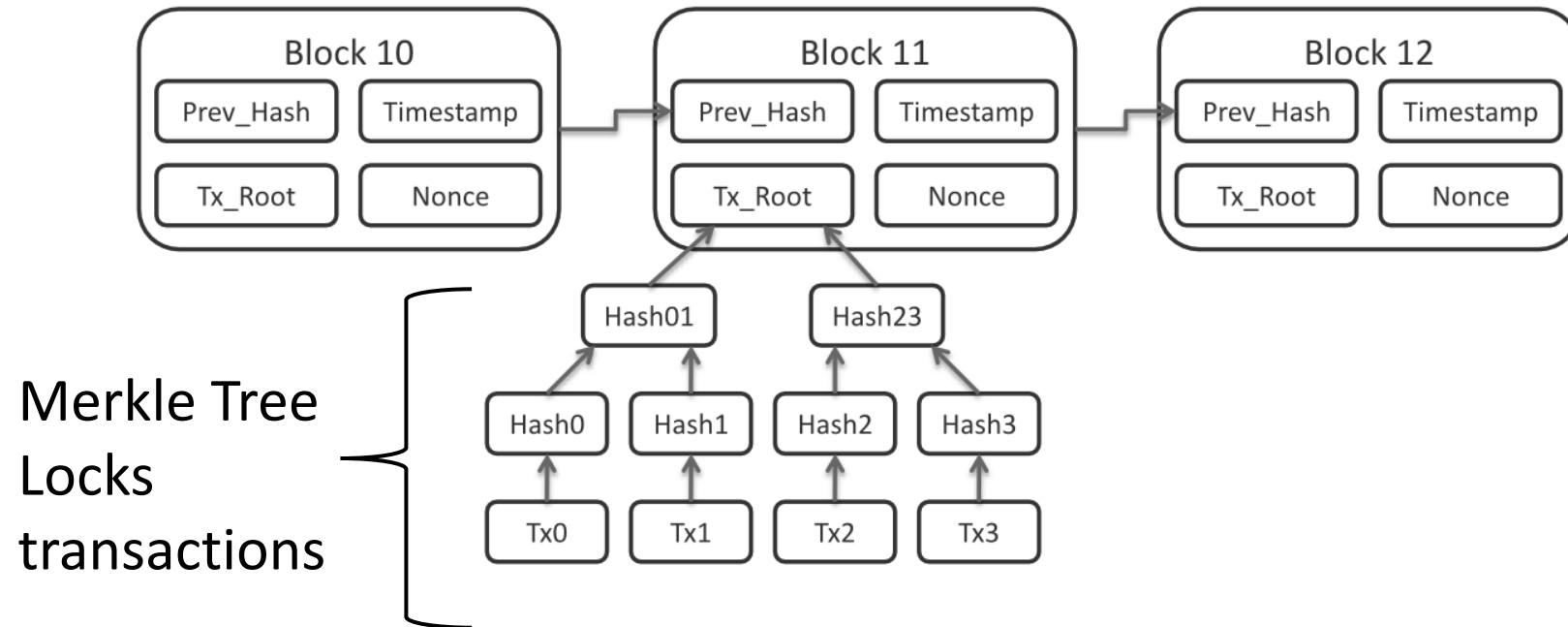
The background of the slide features a blue-toned city skyline at night, with numerous skyscrapers and lights. Overlaid on this is a complex network of white lines connecting various circular nodes, some of which are glowing. This network pattern is spread across the entire slide, creating a digital or technological atmosphere.

# BlockChain Operations

John R Williams, MIT  
Transforming the FinTech Revolution

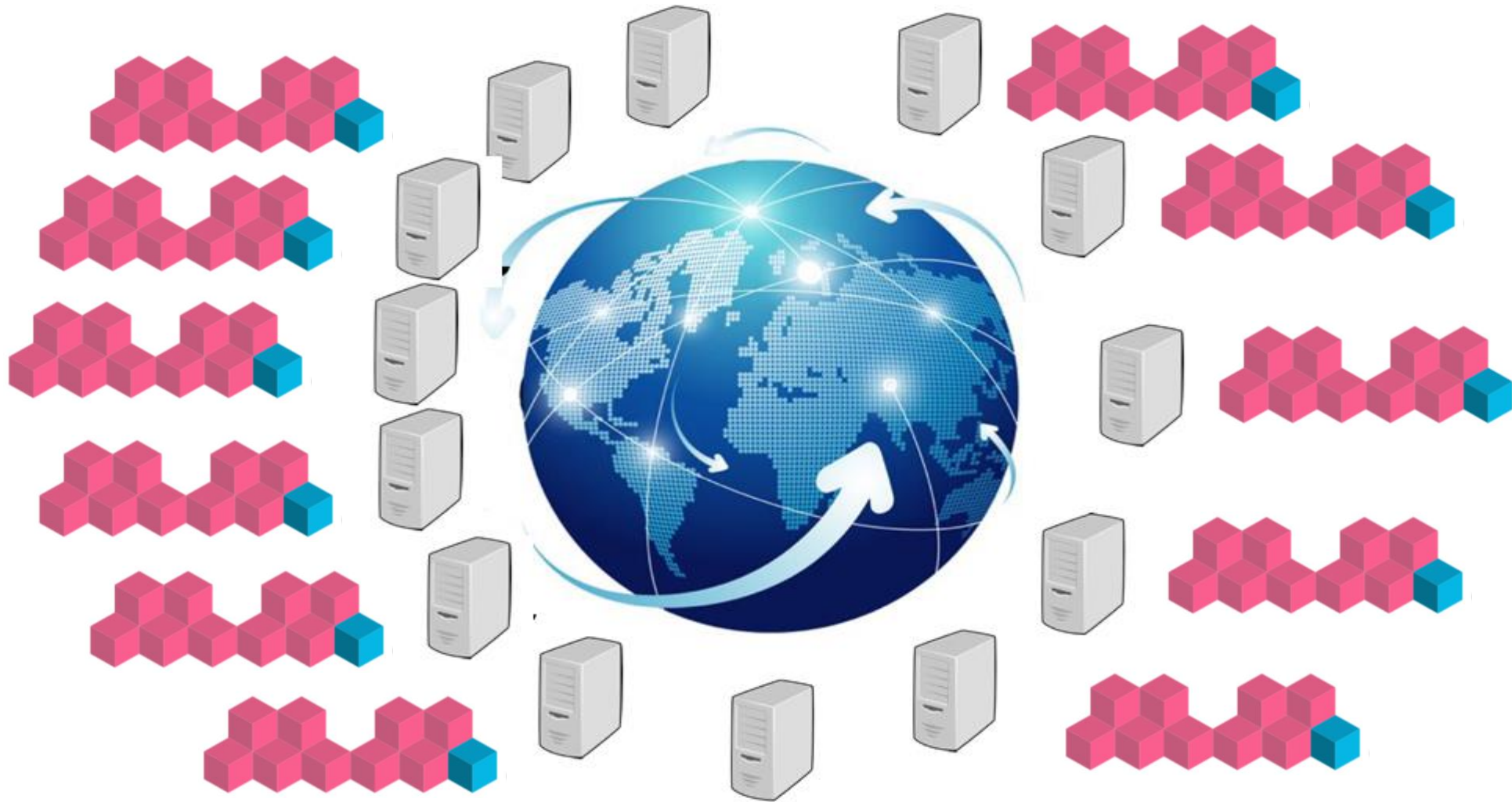
# Merkle Tree Locks Transactions and Hashes Chain Blocks

$\text{Hash}(\text{Prev\_Hash} + \text{Tx\_Root} + \text{Nonce}) \rightarrow 000000\text{bc9xxx}$



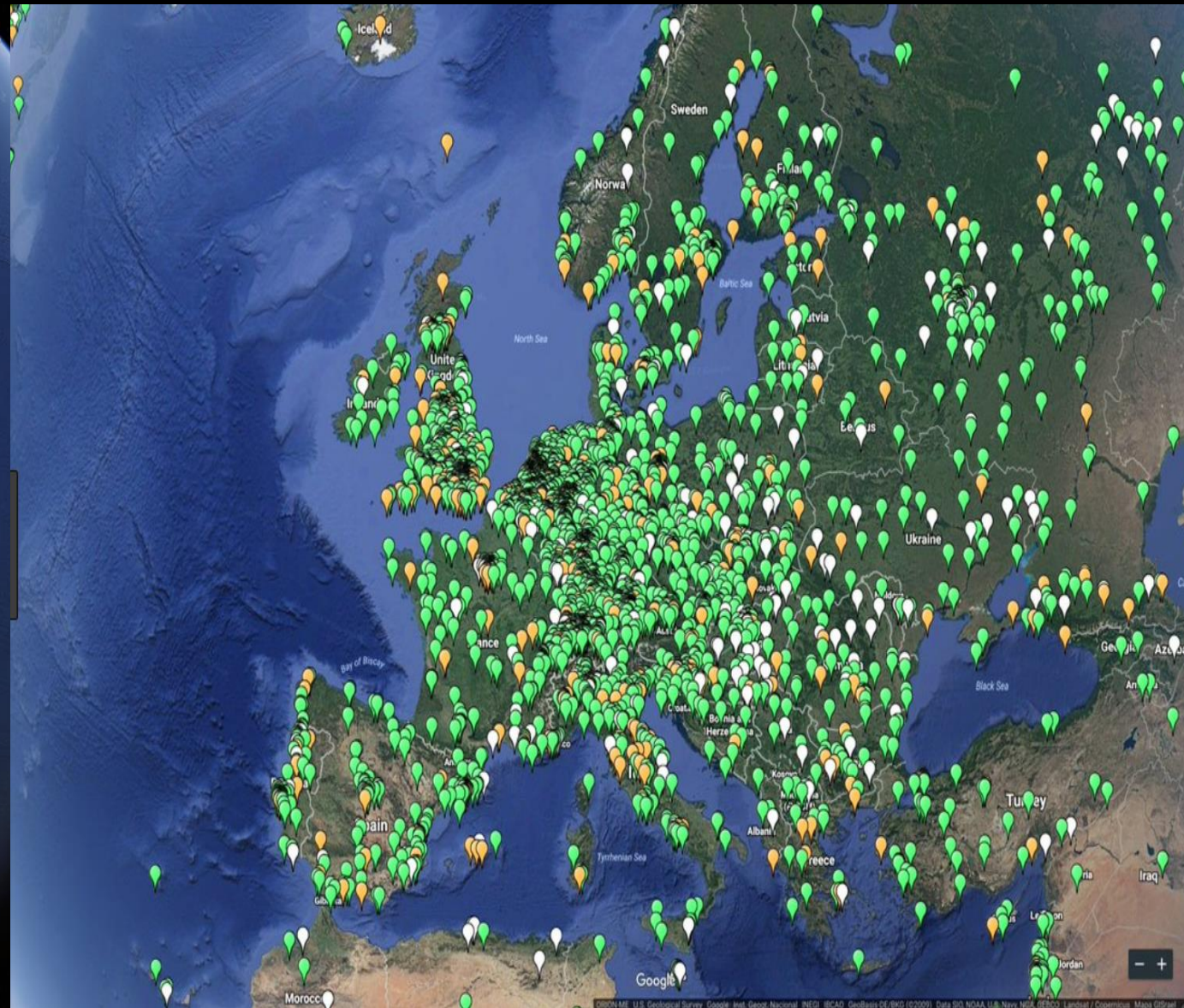


# Can we build a system where we all agree on the exact same transactions and their order?

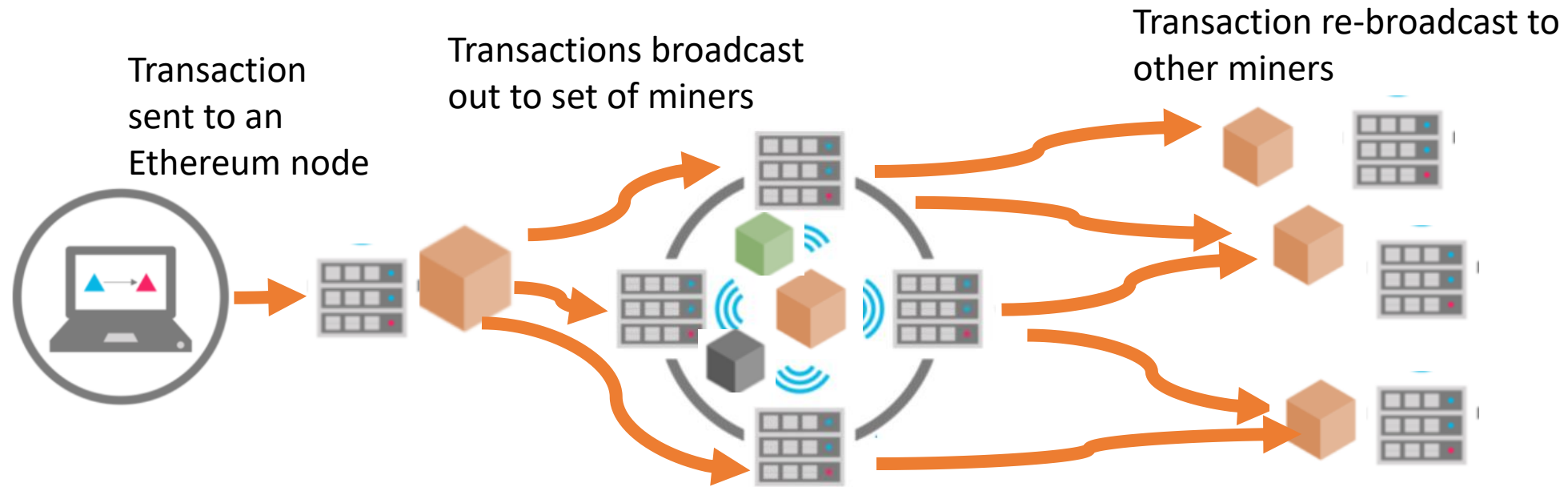




# Ethereum Nodes



# Transaction sent to one Ethereum node. That node broadcasts it to others who broadcast to others ...

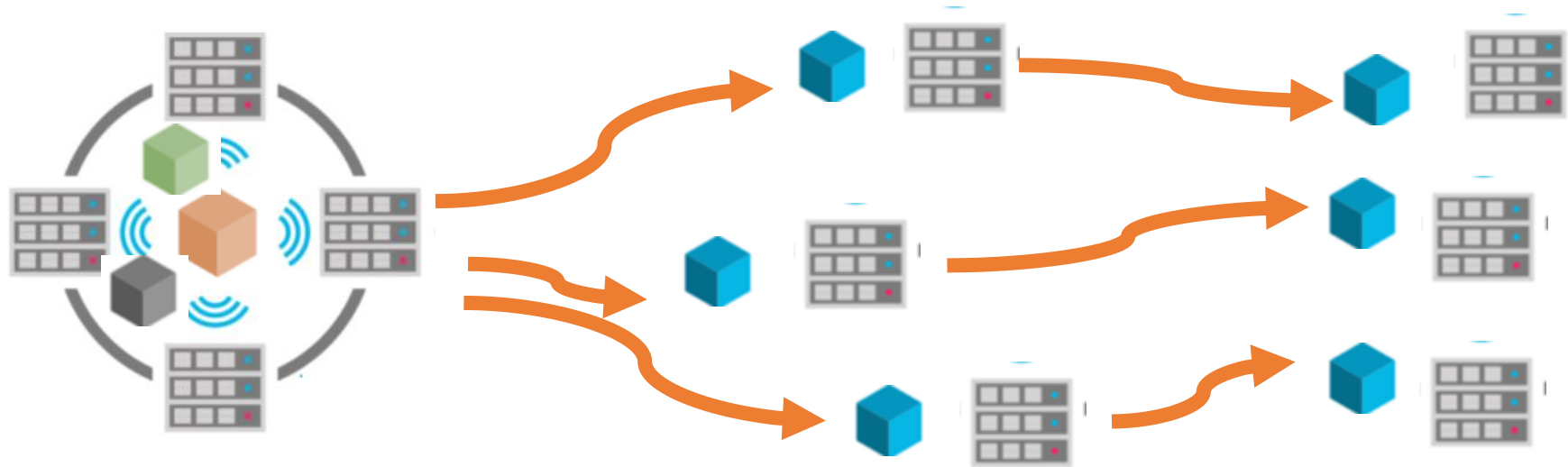




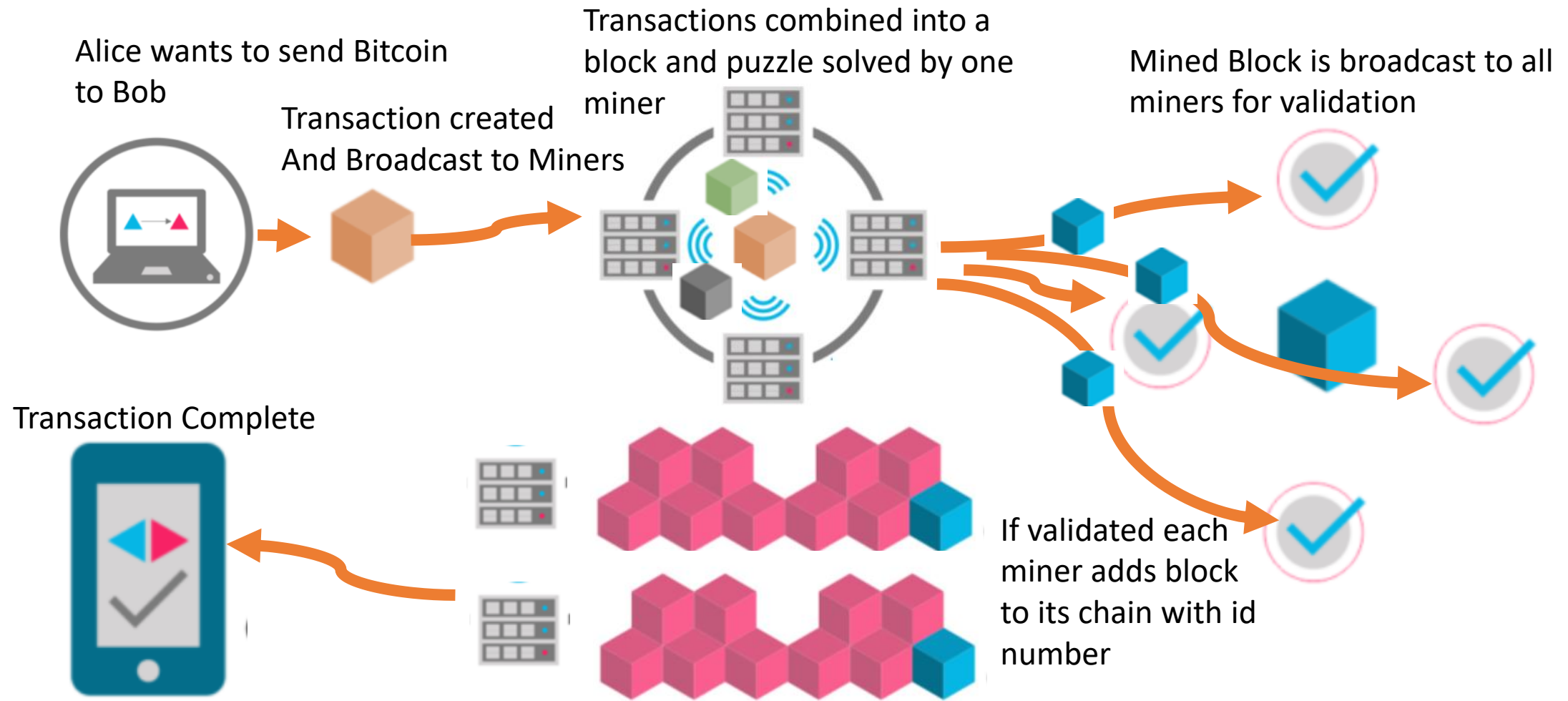
Your transaction may or may not be combined into a block.  
Miners race to form a valid block by solving puzzle



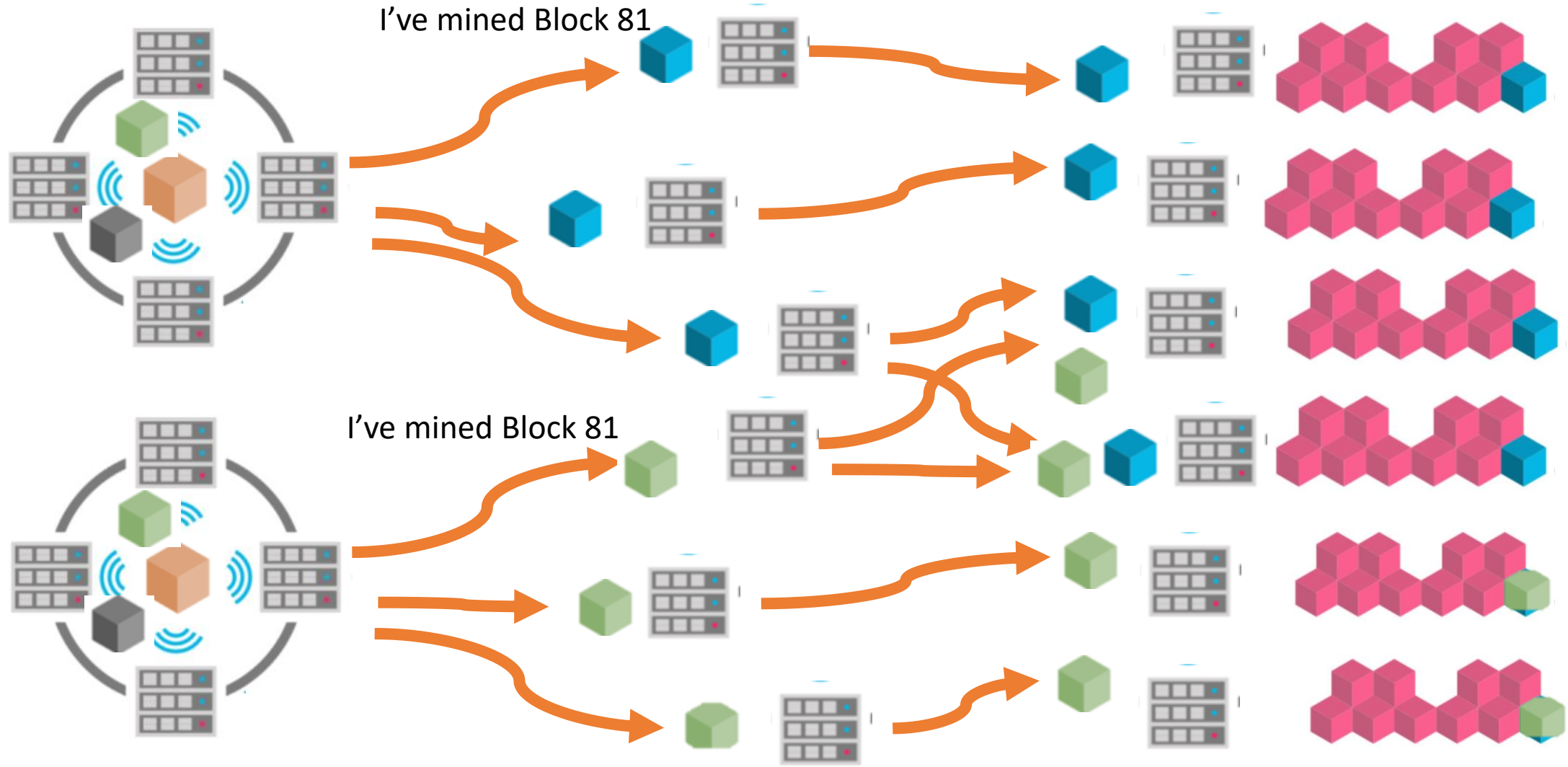
Winning miner broadcasts block to set of other miners who check solution and re-broadcast it



# Mining a Block Workflow

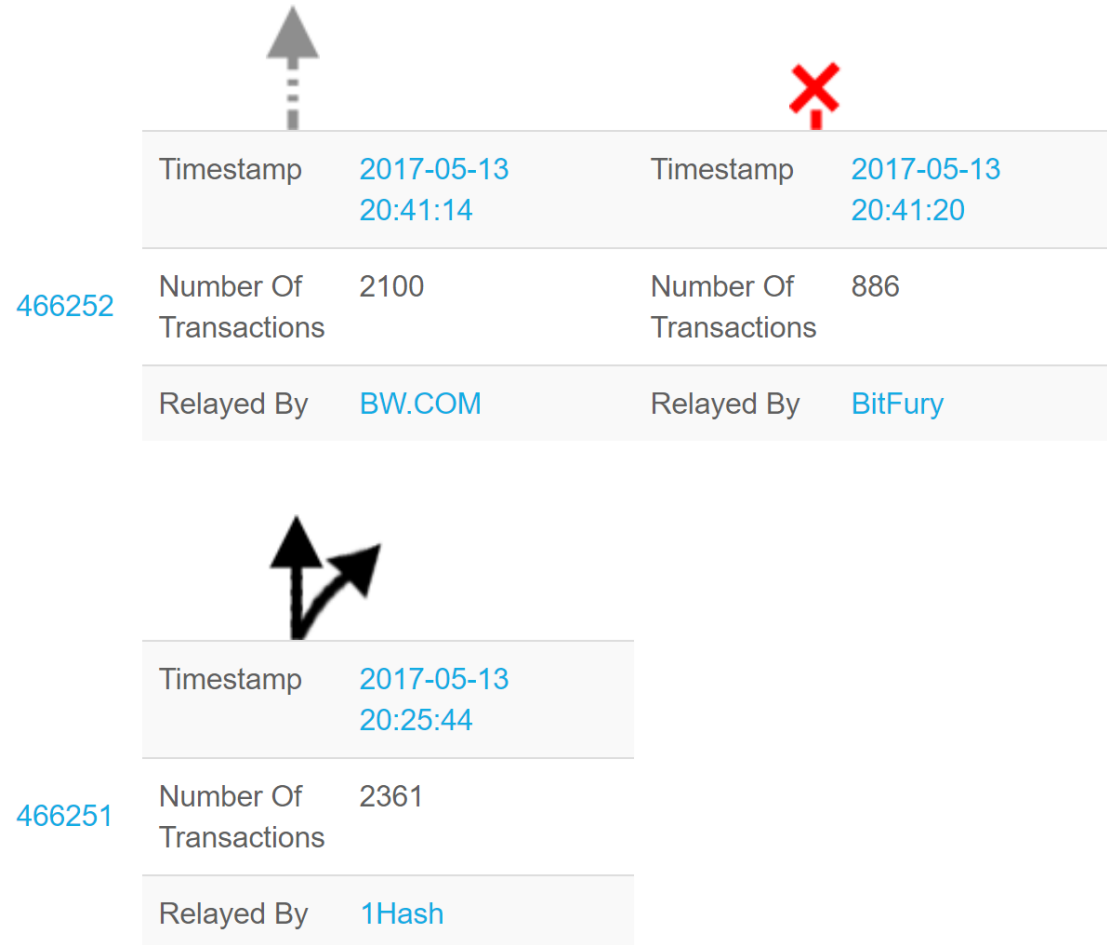


# Two mining pools produce different blocks at similar time





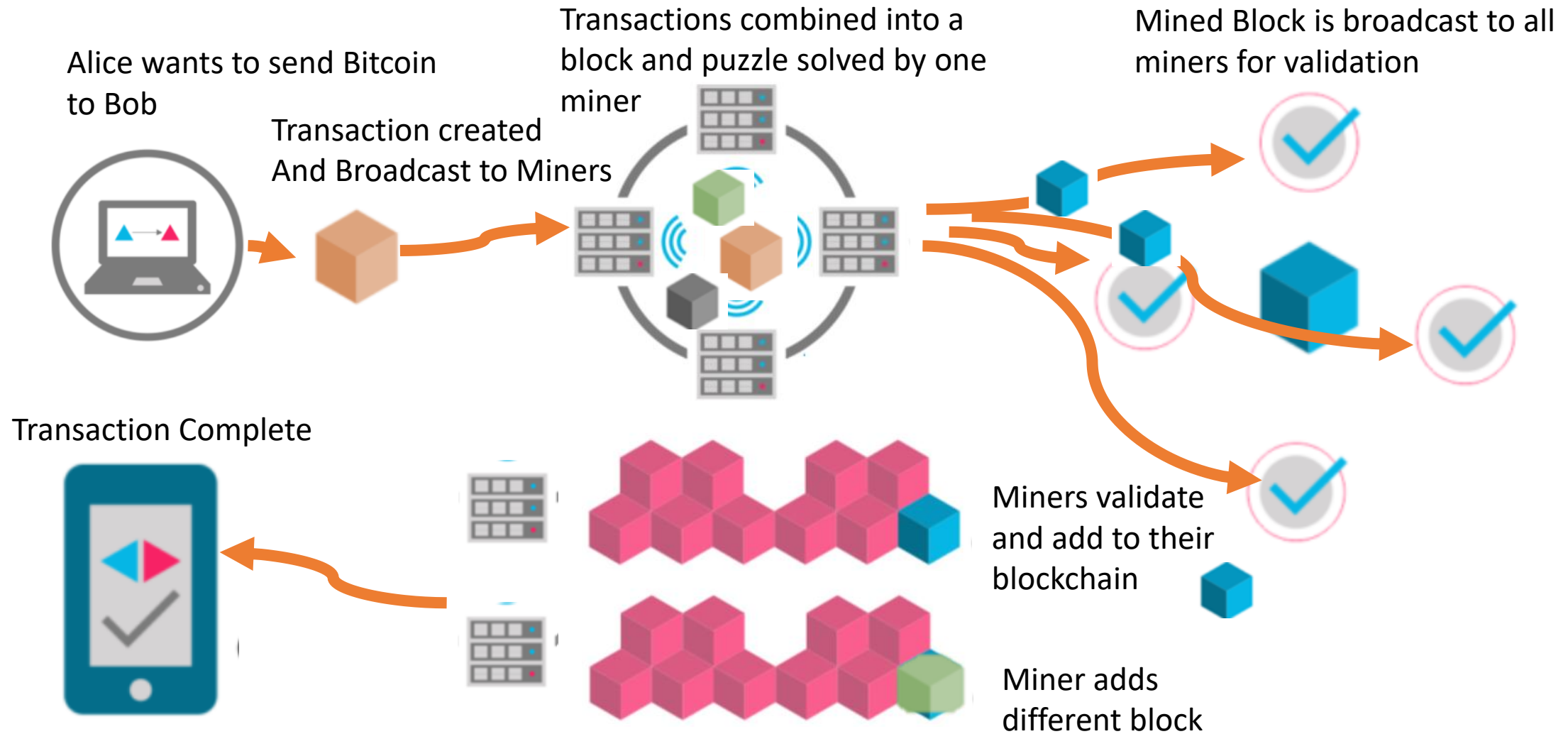
# Two blocks mined at almost same time – actual Ethereum



466252	Timestamp	2017-05-13 20:41:14	Timestamp	2017-05-13 20:41:20
	Number Of Transactions	2100	Number Of Transactions	886
	Relayed By	BW.COM	Relayed By	BitFury
466251	Timestamp	2017-05-13 20:25:44		
	Number Of Transactions	2361		
	Relayed By	1Hash		

“orphaned”  
block

# Blockchain Consensus in BitCoin





Address

0x16E0022b17B...

0 Ether



Balance



State



Logs – changes are logged and events raised



# Client's apps can monitor events

