

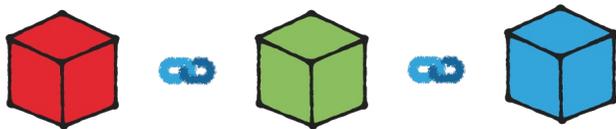
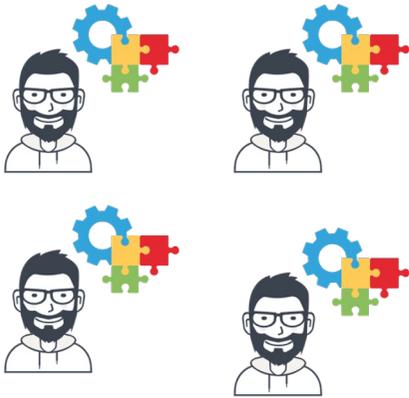
# How Exclusive are Ethereum Transactions? Evidence from non-winning blocks

**Vabuk Pahari** and Andrea Canidio

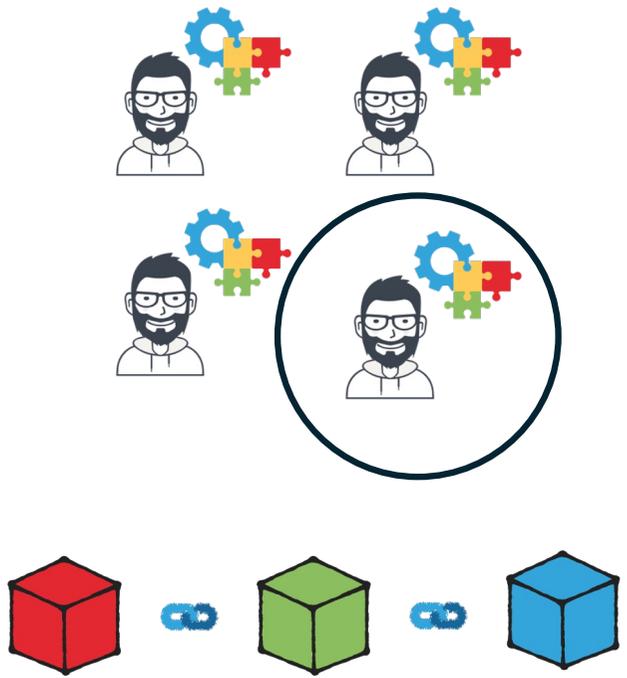
Max Planck Institute for Software Systems

February 24, 2026

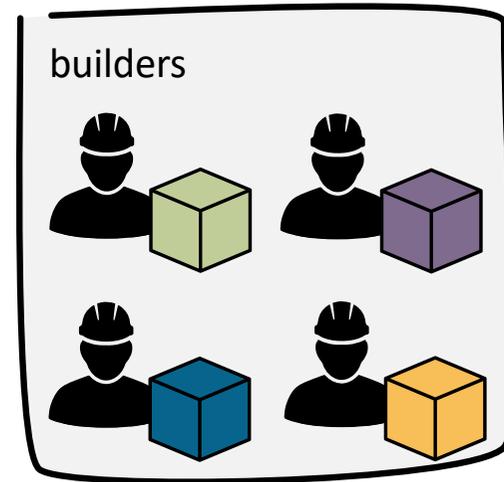
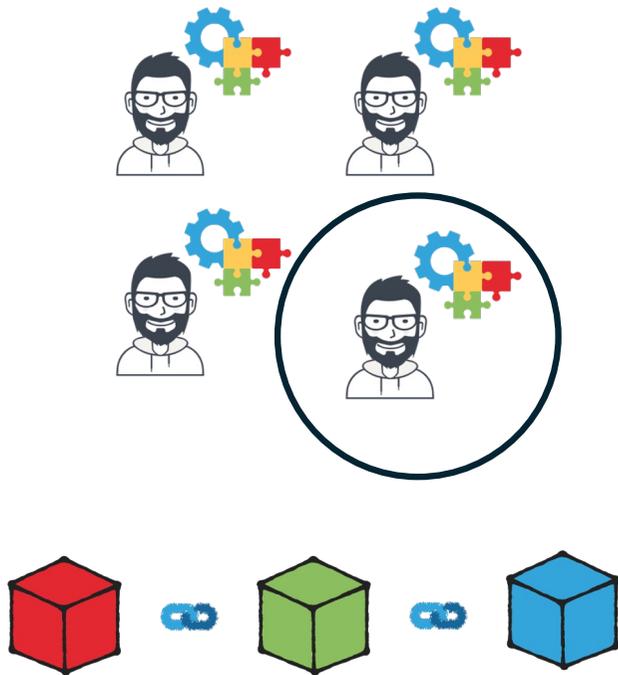
# Ethereum block building



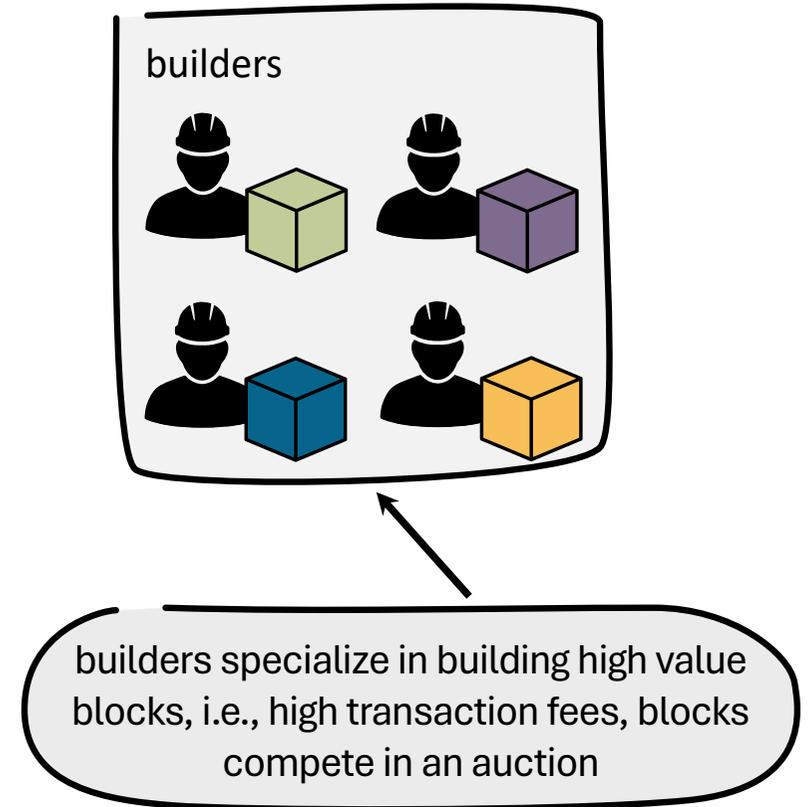
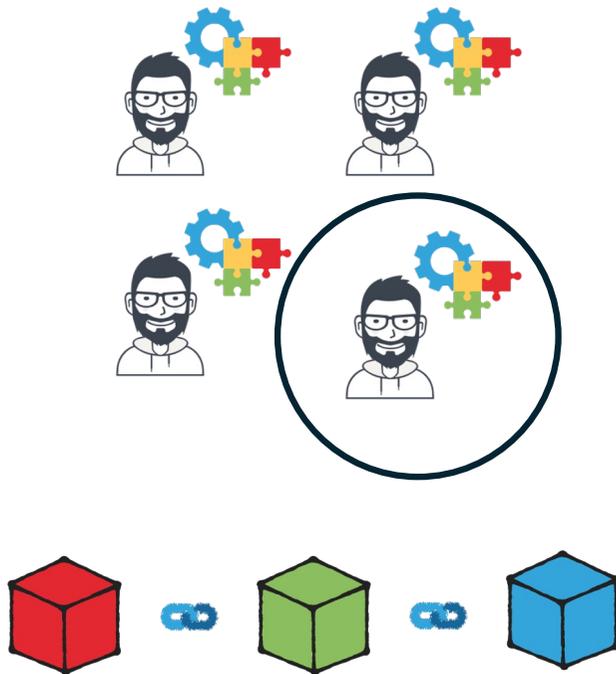
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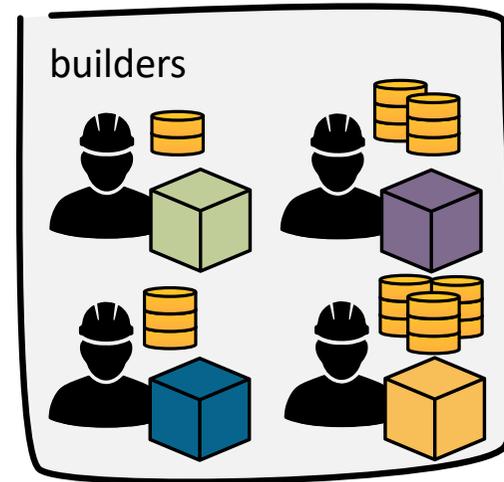
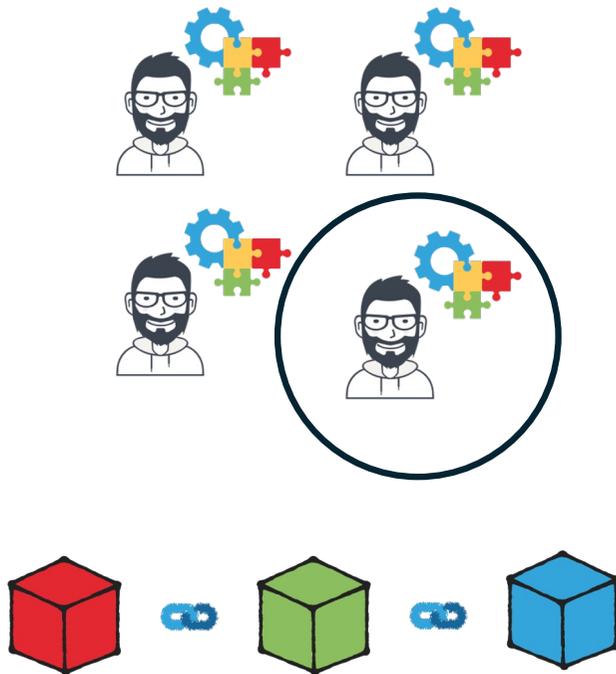
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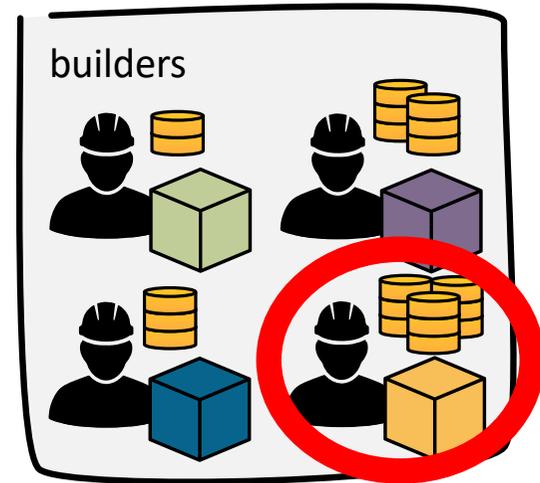
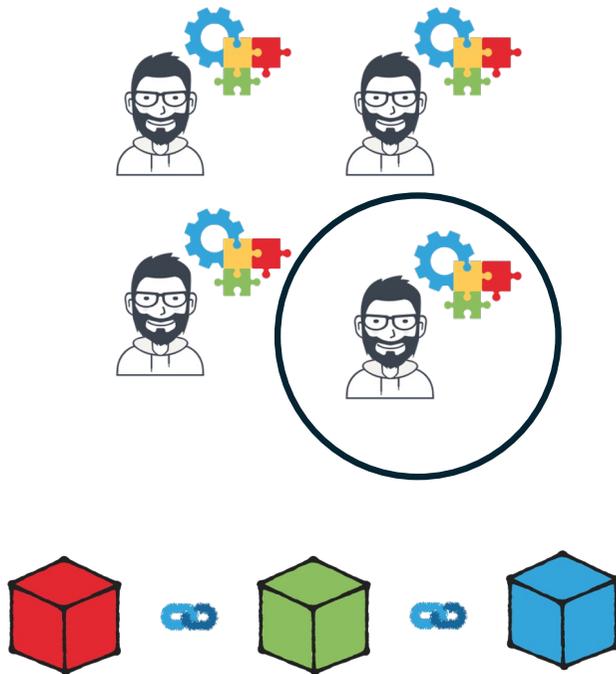
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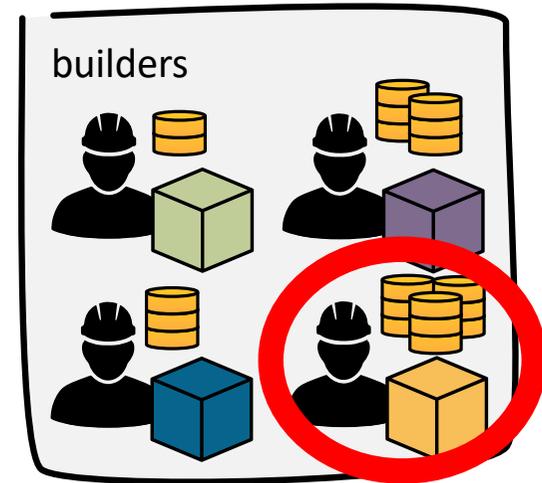
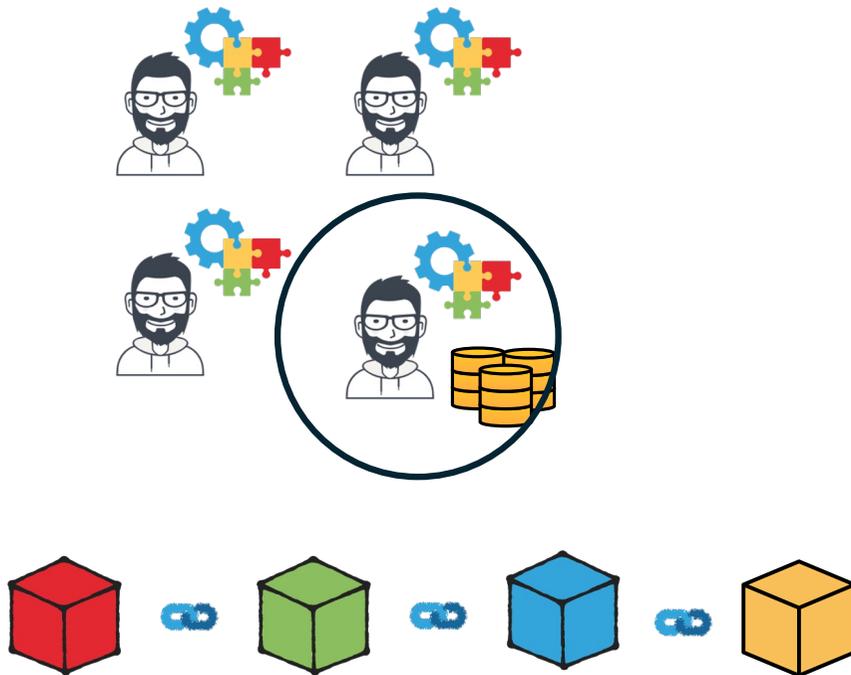
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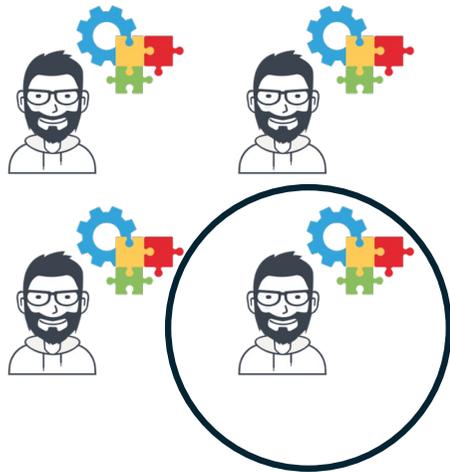


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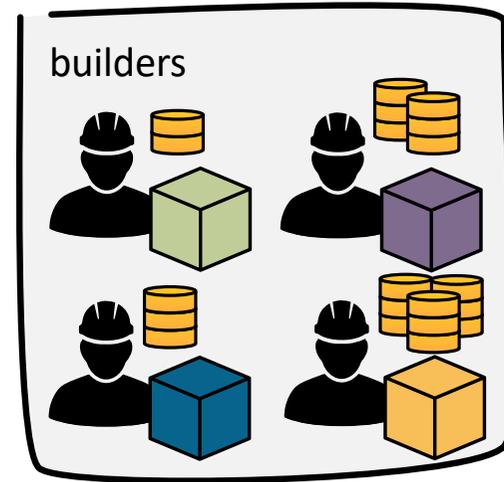


the right to build a block can be very valuable

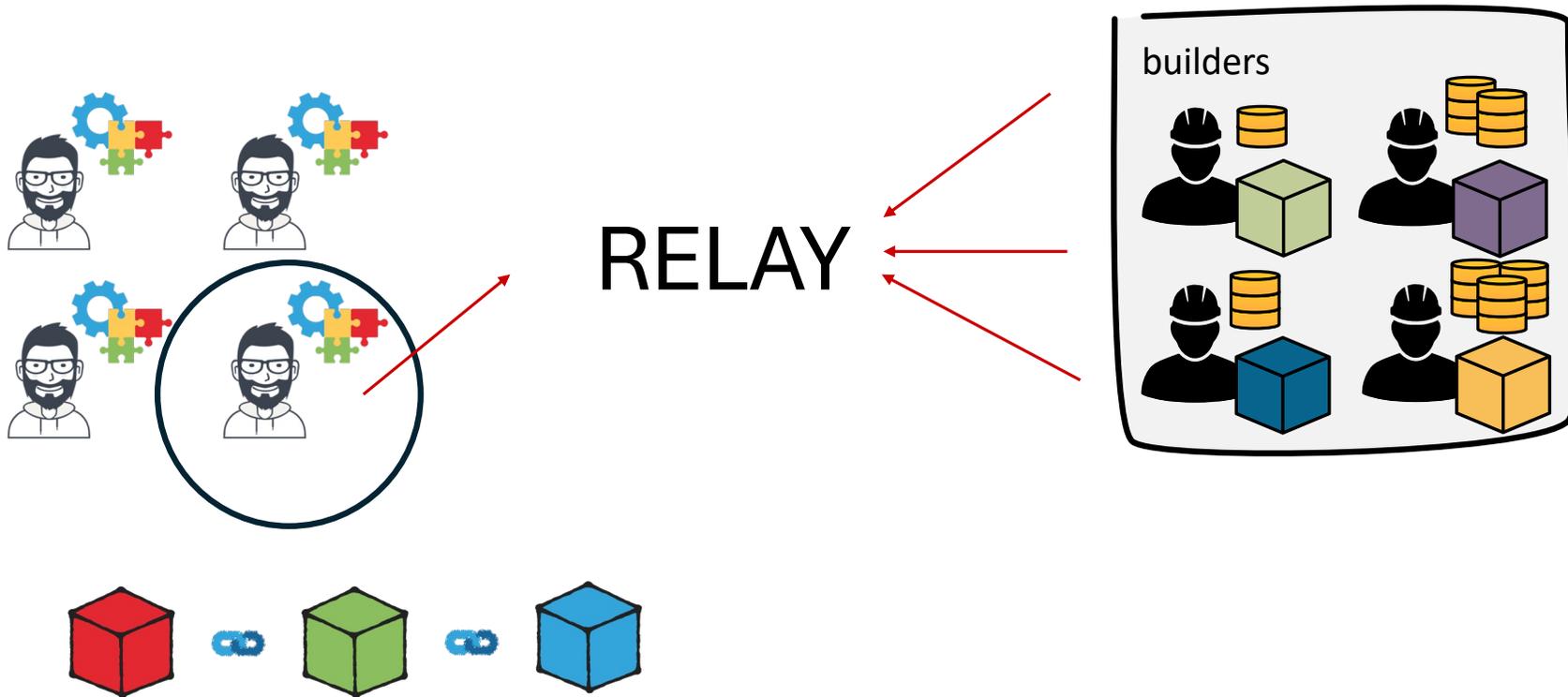
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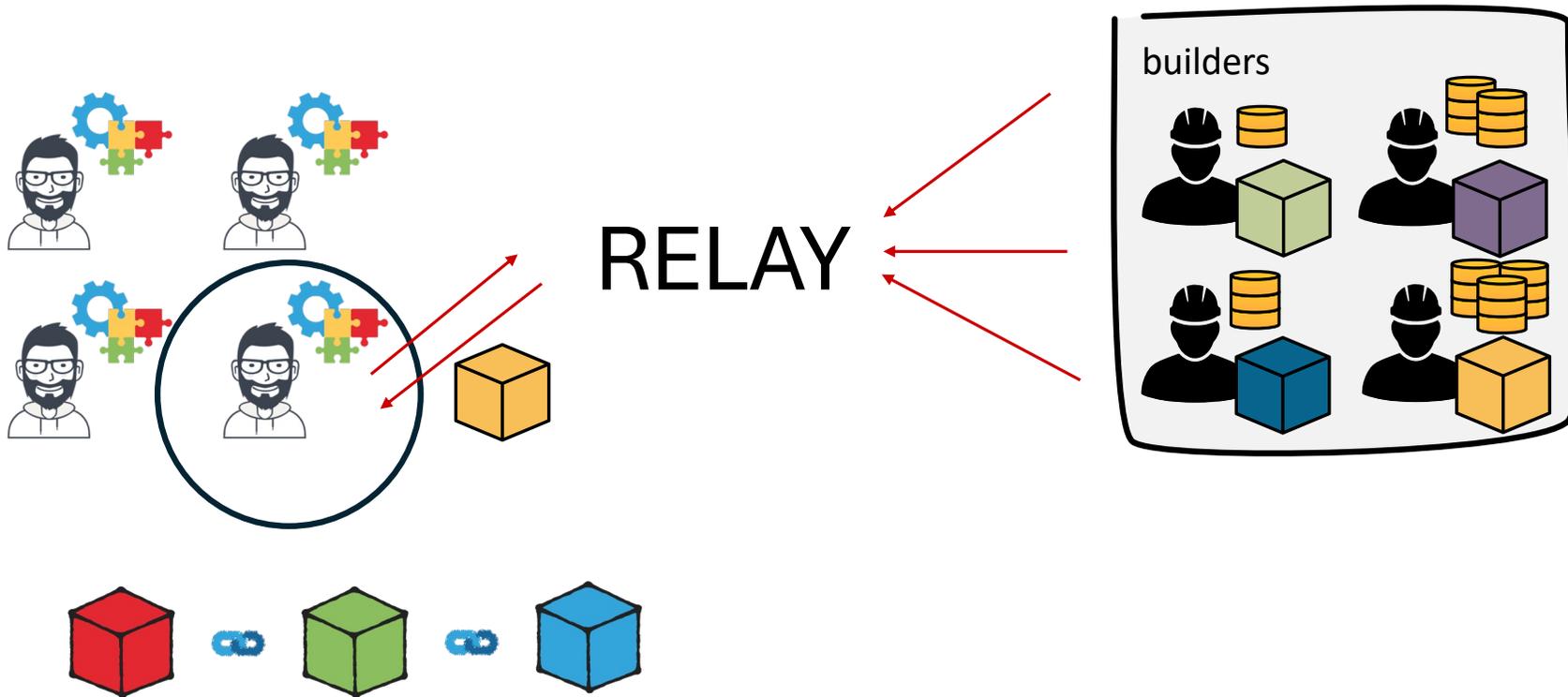
RELAY



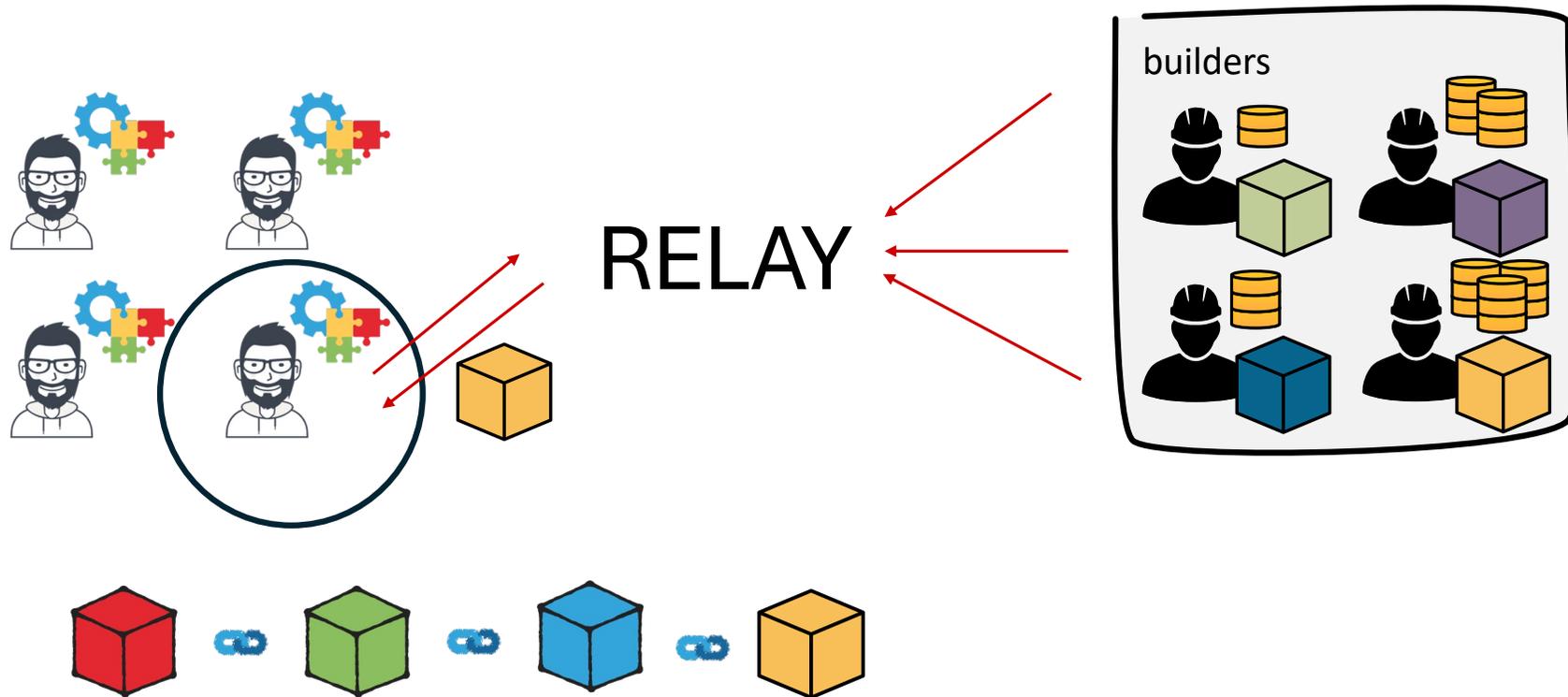
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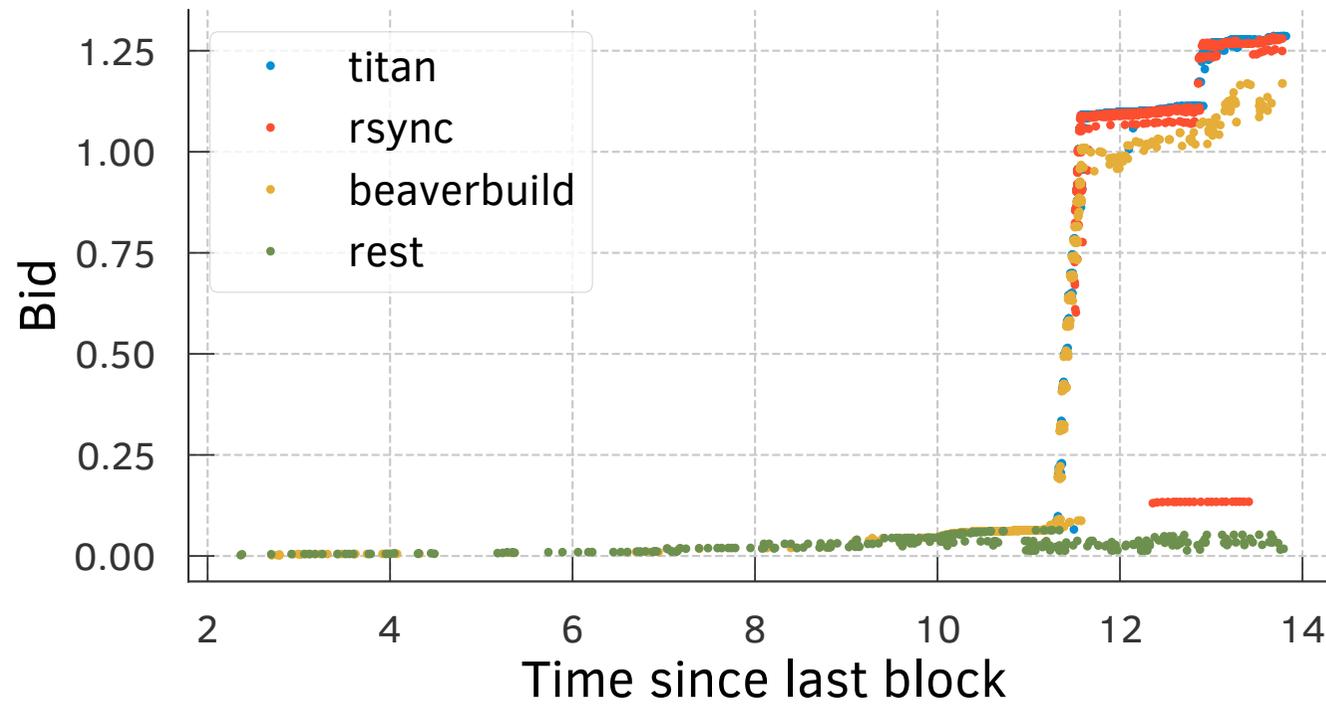
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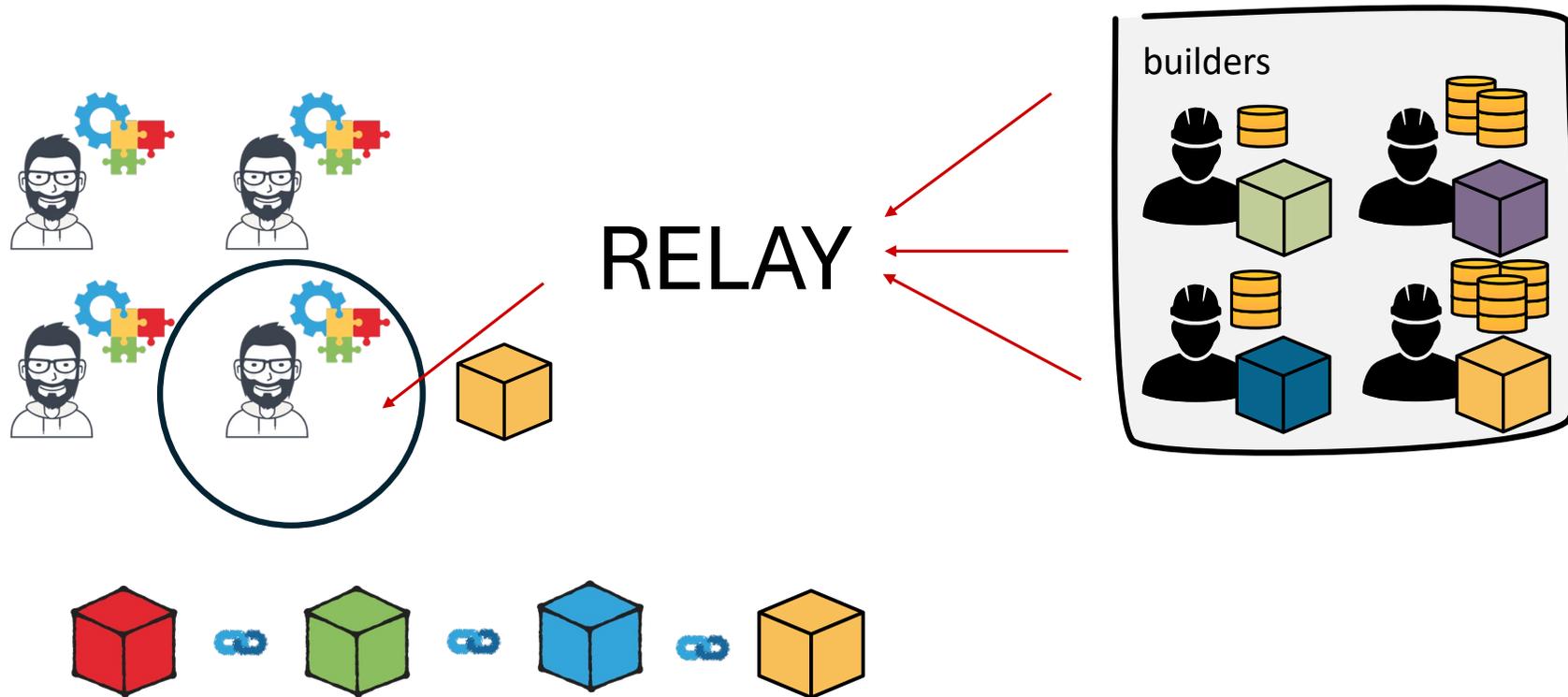
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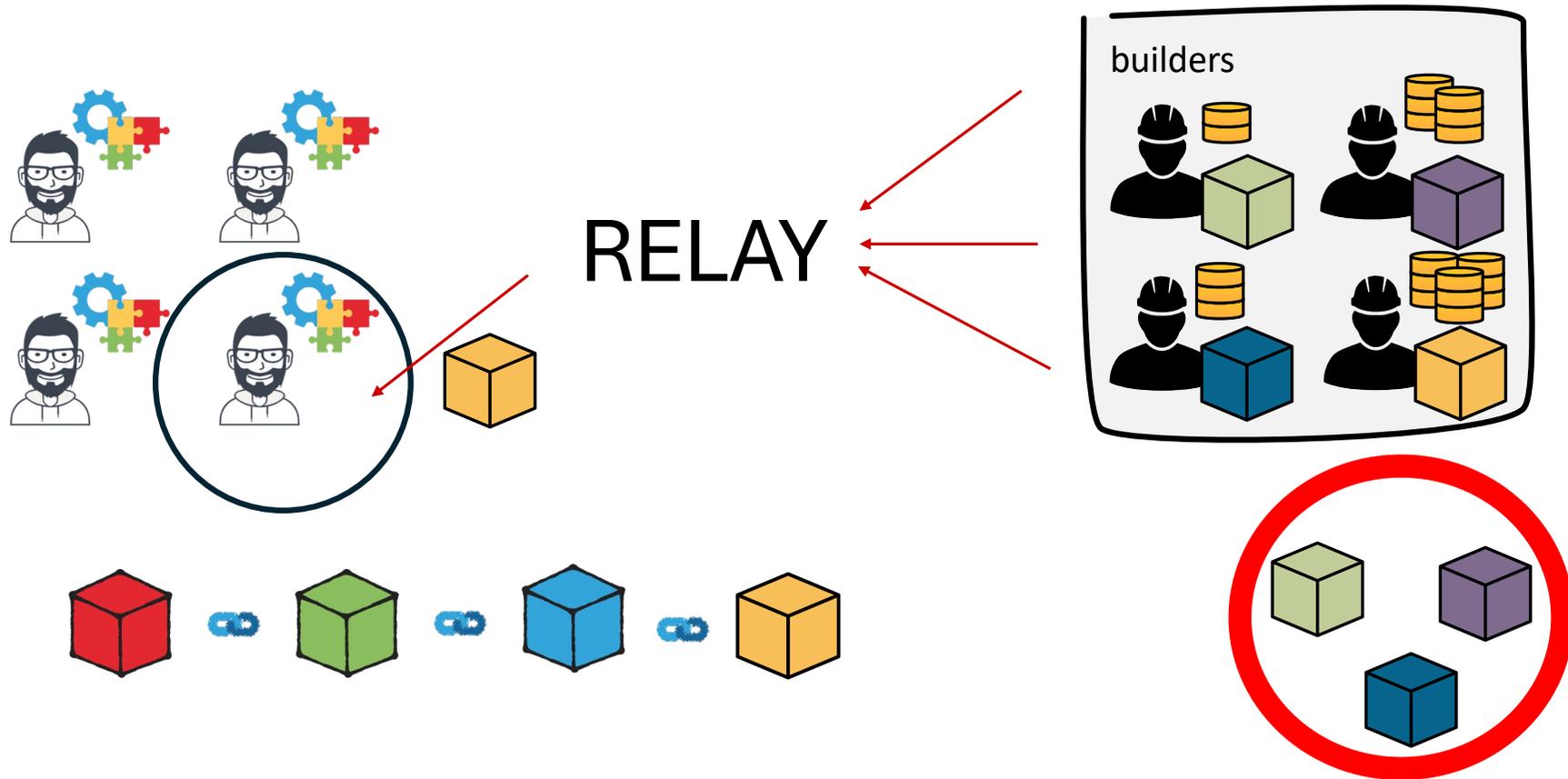
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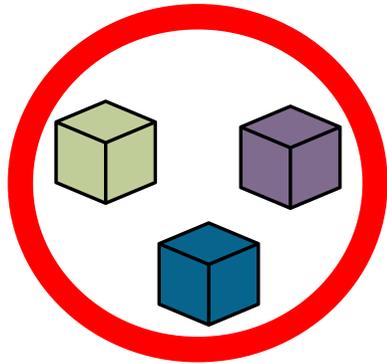
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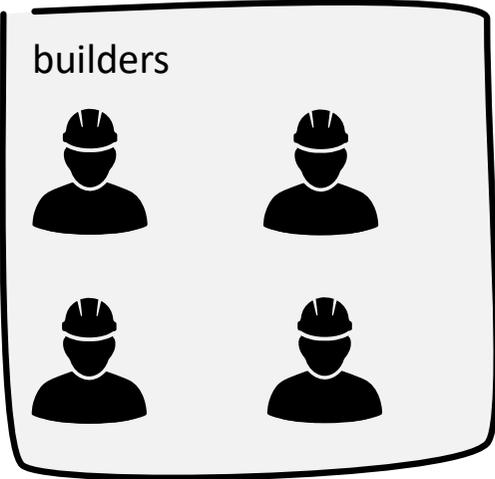
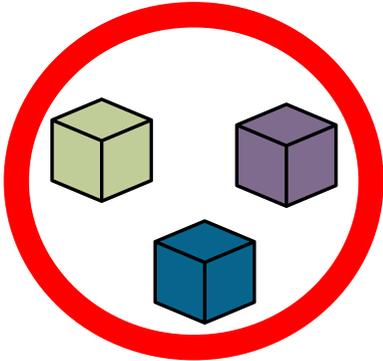
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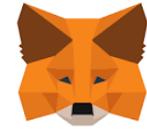
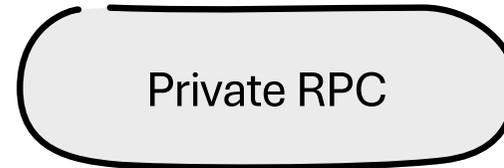
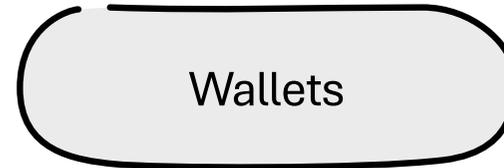
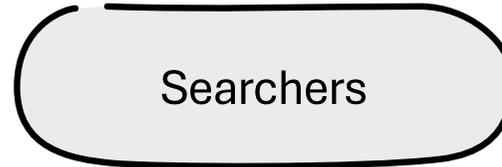
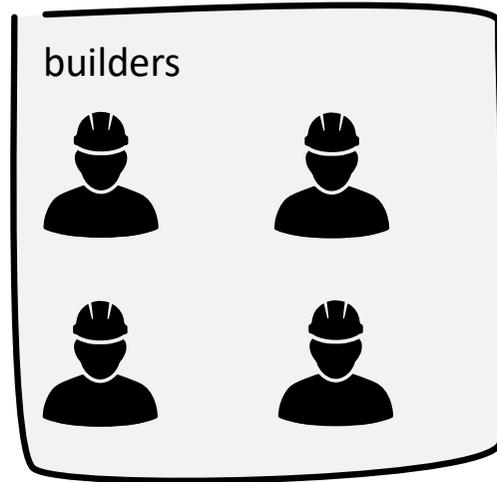
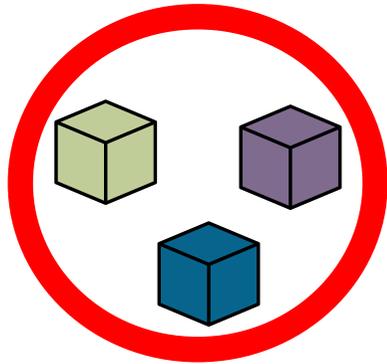
# This Talk



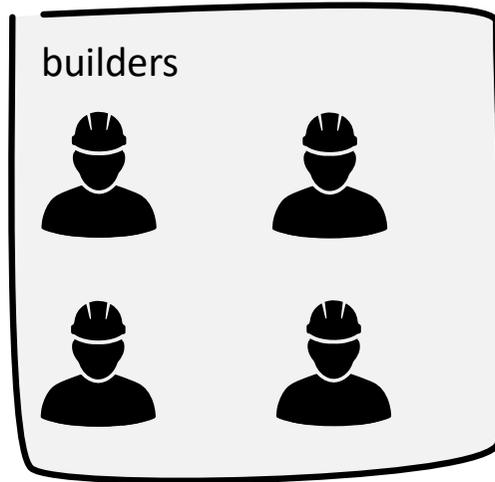
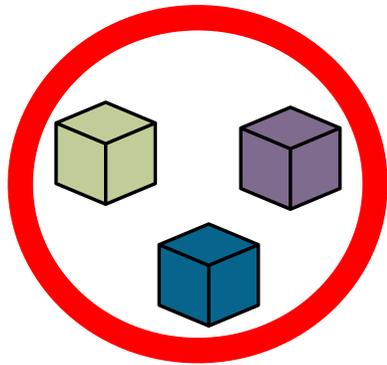
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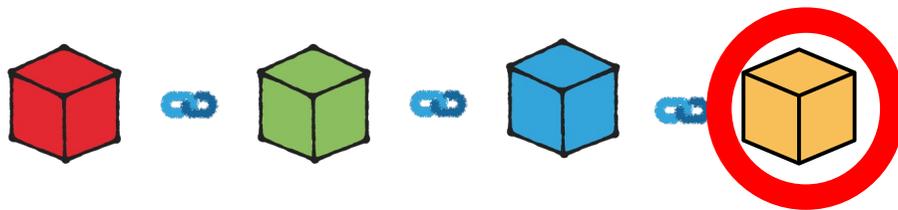
# This Talk



Searchers

Wallets

Private RPC



# Dataset

- 15,097 unique blocks (representing 28% of all blocks)
- 10,793 transactions (based on tx hashes)
- 5,576 transactions eventually included on-chain

# Dataset

- All blocks going through Agnostic Relay for 8 minutes between 2:37:35 PM to 2:45:25 PM, December 3rd 2024
- Block numbers 21,322,622 - 21,322,660 (39 blocks)
- 28 unique auctions

# This Talk

- Exclusivity of transactions
  - Transaction hash
  - Log-based
- Transitioning transactions

# Included Transactions

- **Public**
- **Private**
- **Exclusive**

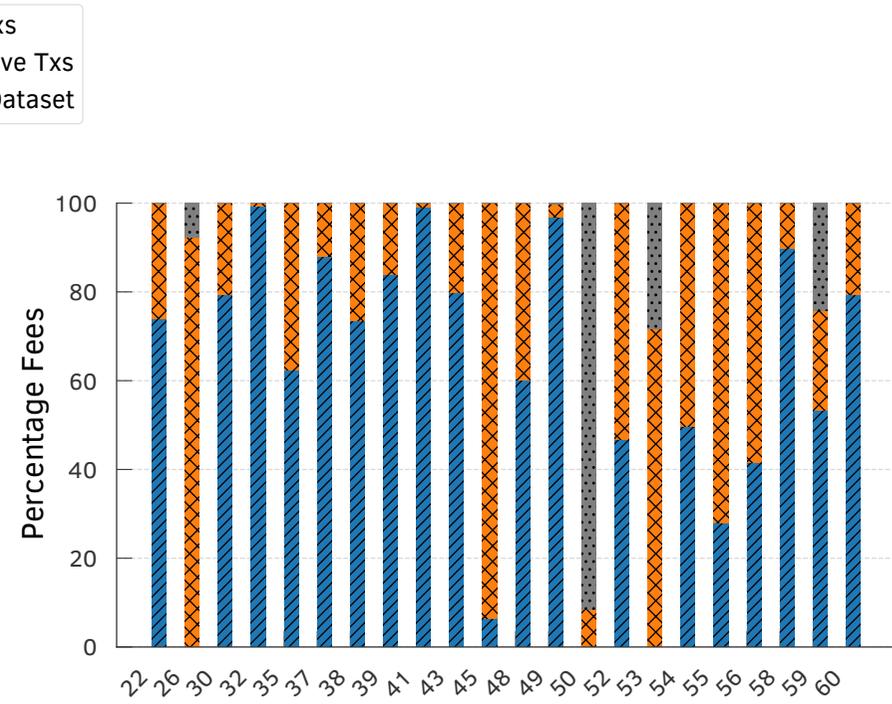
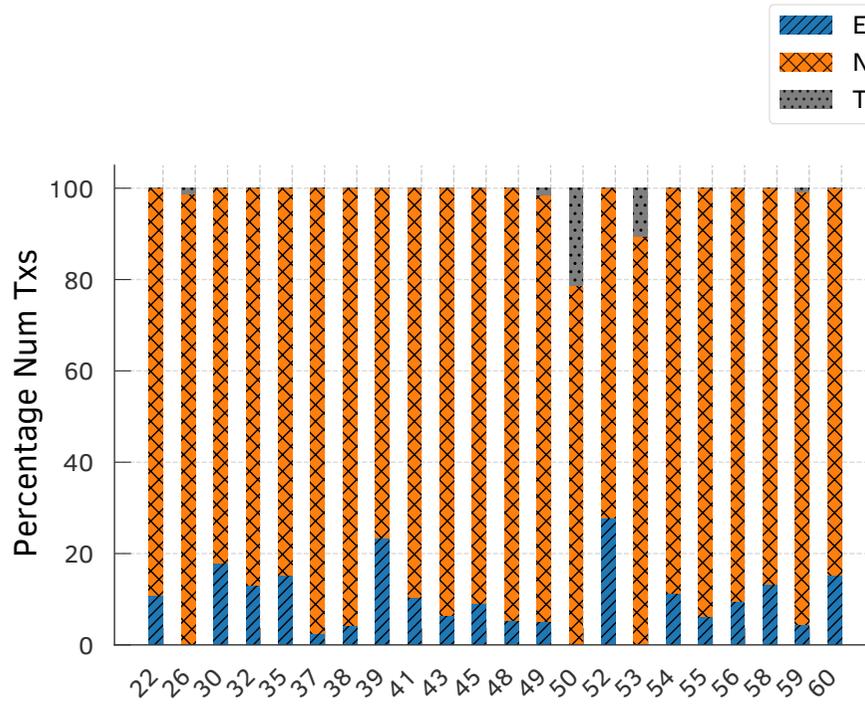
# Included Transactions

	NUM TXS
• <b>Public</b>	4,124 (74%)
• <b>Private</b>	810 (15%)
• <b>Exclusive</b>	642 (11%)

# Included Transactions

	NUM TXS	FEES
• <b>Public</b>	4,124 (74%)	0.74 ETH (5%)
• <b>Private</b>	810 (15%)	1.66 ETH (11%)
• <b>Exclusive</b>	642 (11%)	12.27 ETH (84%)

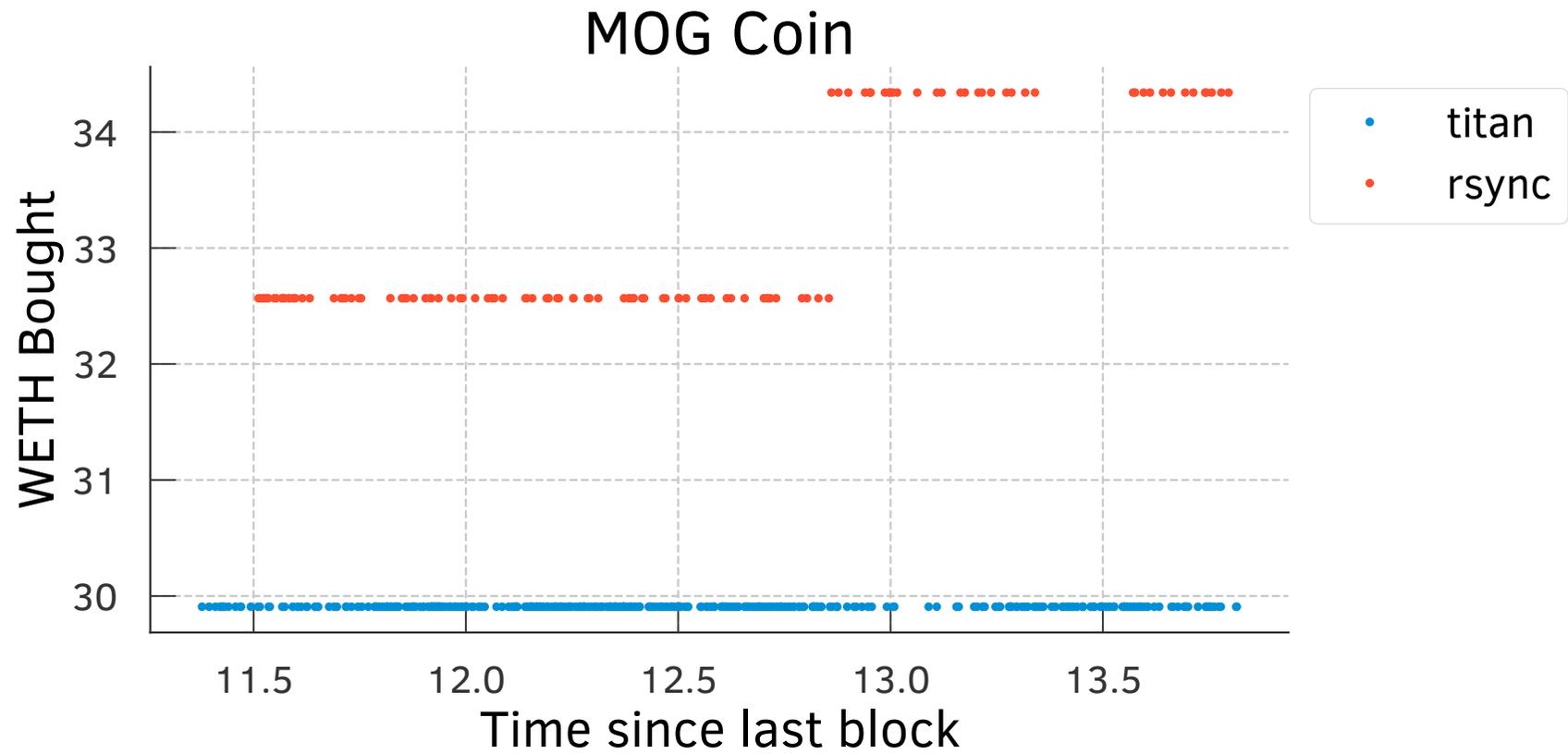
# Included Transactions



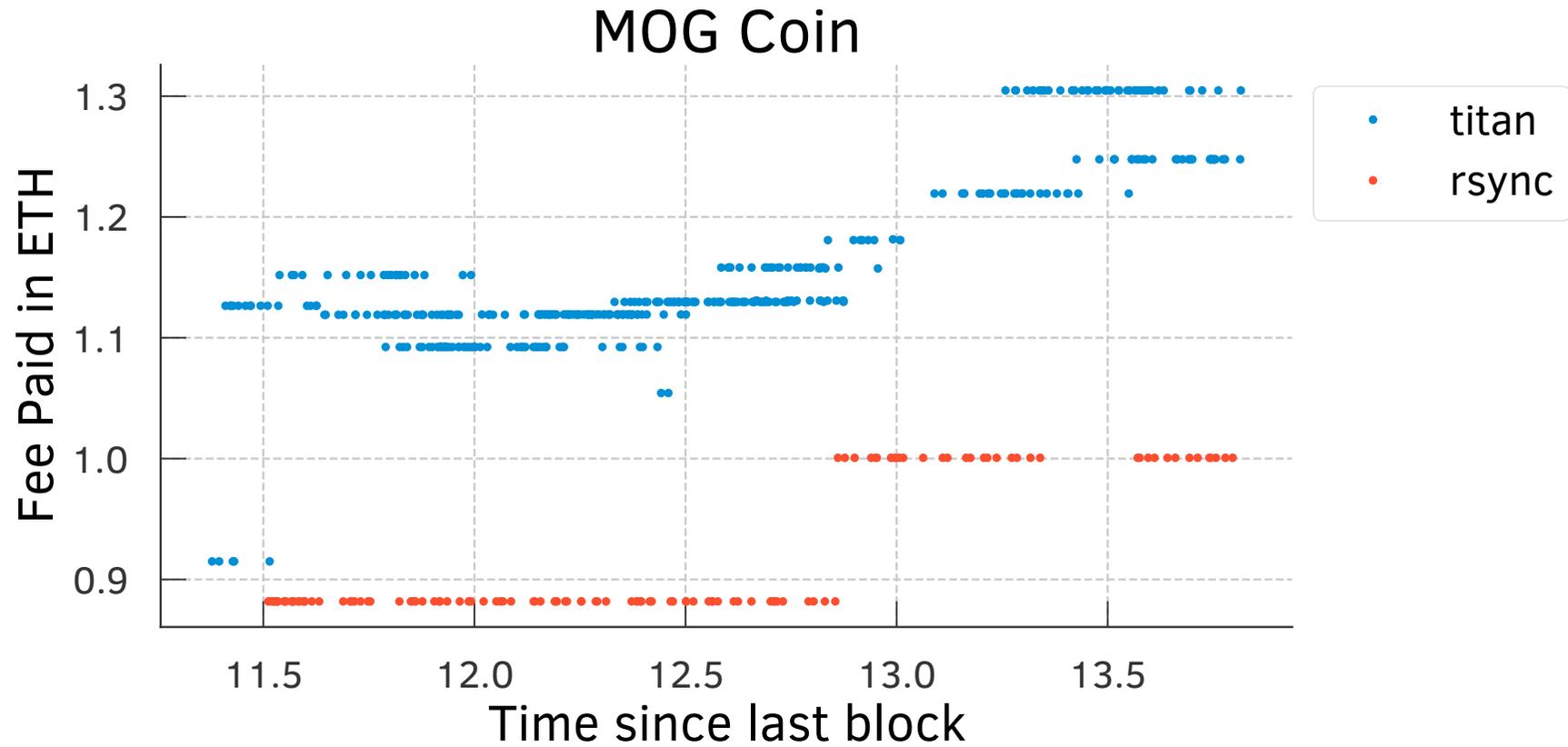
# Not-Included Transactions

	Included Txs	Not Included Txs
• <b>Public</b>	4,124 (74%)	0 (0%)
• <b>Private</b>	810 (15%)	448 (8.6%)
• <b>Exclusive</b>	642 (11%)	4,769 (91.4%)

# Included Transactions



# Included Transactions



# Log-based Classification

- Same transaction but different tx hashes
- Two types of log-based classification
  - Logs are the same but transaction hash is different
  - Swaps in the same pool but different amounts

# Log-based Classification

- 665 transactions with 279 unique logs
  - 171 are exclusive with 59 unique logs to the same builder
  - 494 are **partially-exclusive** with 220 unique logs to different builders
- The builder receiving the highest fee received **23%** more fees

# Log-based Classification

- 1,179 **similar** transactions into 162 unique logs
- The highest paid builder is paid on average **70%** more than the second highest

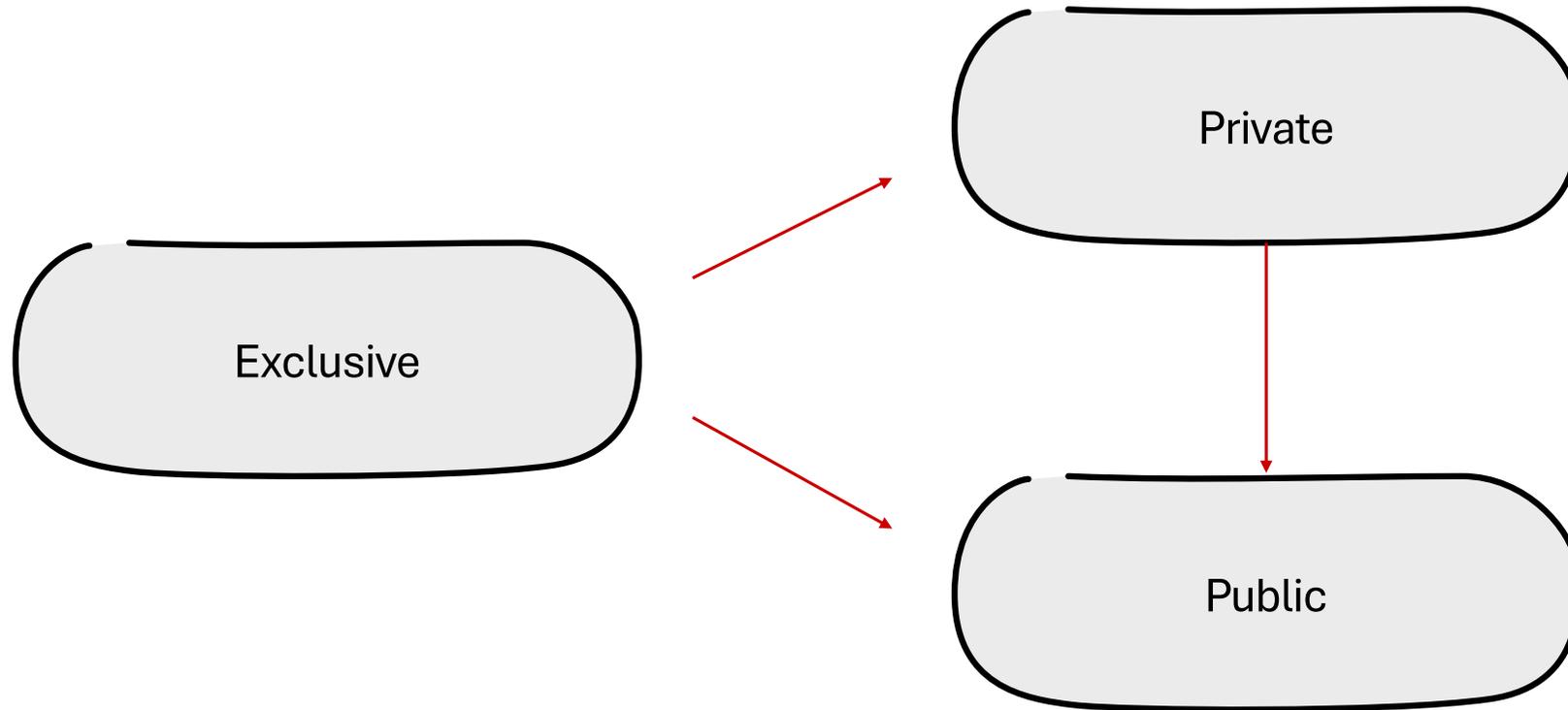
# Included Transactions

	NUM TXS	FEES
• <b>Public</b>	4,124 (74%)	0.74 ETH (5%)
• <b>Private</b>	810 (15%)	1.66 ETH (11%)
• <b>Exclusive</b>	642 (11%)	12.27 ETH (84%)

# Included Transactions

	NUM TXS	FEES	
• <b>Public</b>	4,124 (74%)	0.74 ETH (5%)	0.74 ETH (5%)
• <b>Private</b>	810 (15%)	1.66 ETH (11%)	<b>2.6 ETH (18%)</b>
• <b>Exclusive</b>	642 (11%)	12.27 ETH (84%)	<b>11.33 ETH (77%)</b>

# Transaction Transitions



# Transaction Transitions (Across Cycles)

- 17% of txs in the public mempool are not included in the first auction cycle they appear in
- 12 initially exclusive txs then appeared in the public mempool
  - One was sandwiched

# Transaction Transitions (Within Cycles)

- 20 cases of transaction sharing
  - 3 with Rsync Builder
  - 17 with Titan Builder
- For Rsync, 2 were exclusive to Beaverbuild
- For Titan, 13 were exclusive to Flashbots (8 were included on-chain and 5 were not)

# Implications

- Searchers send separate txs to separate builders with different fees
- User txs are delayed, even though they pay enough fees
  - Leads to attacks when they are leaked to the mempool or different builders

Thank you!



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Systems**

[vpahari.github.io/](https://vpahari.github.io/)