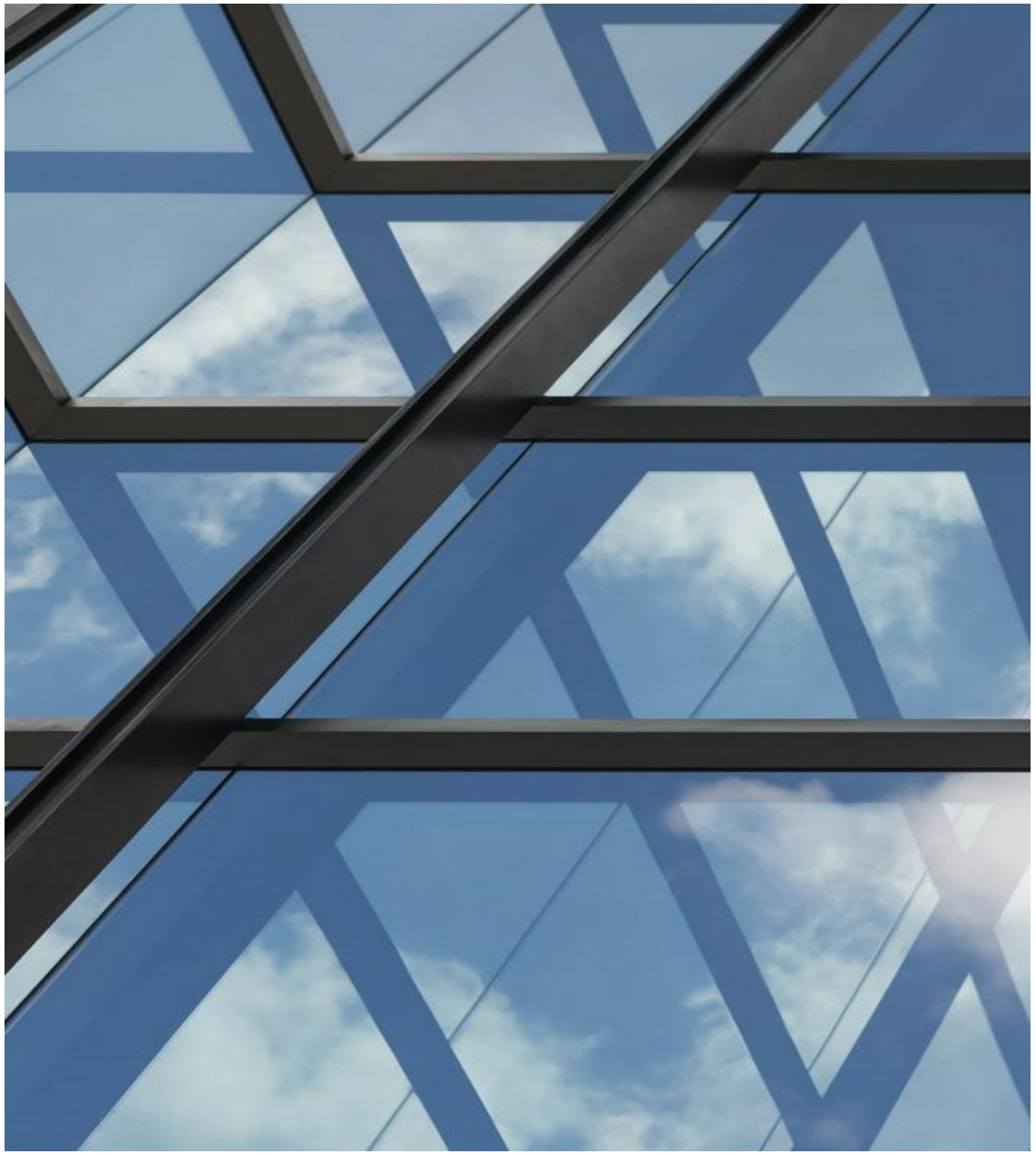
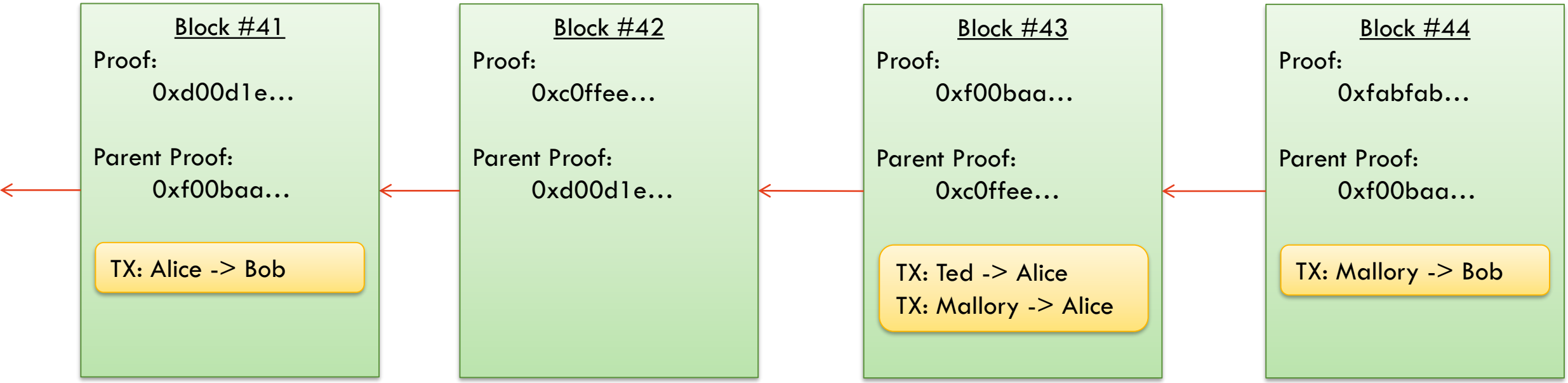
How to Hack Blockchain Systems

Parinya Ekparinya
Vincent Gramoli
Guillaume Jourjon



Blockchain


Block #41
Proof:
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Parent Proof:
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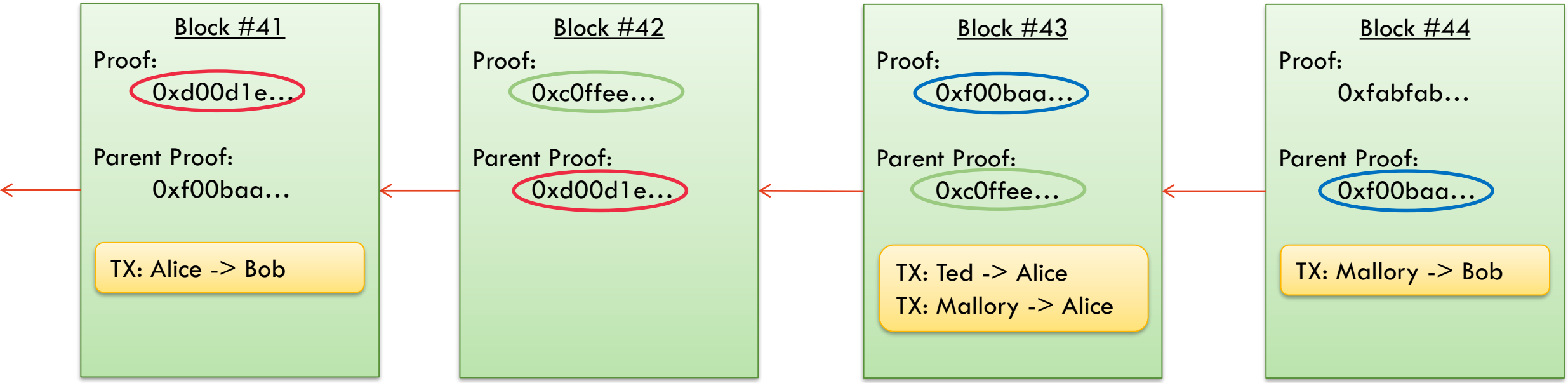
TX: Alice -> Bob
Block #42
Proof:
0xc0ffee...
Parent Proof:
0xd00d1e...
Block #43
Proof:
0xf00baa...
Parent Proof:
0xc0ffee...
TX: Ted -> Alice
TX: Mallory -> Alice
Block #44
Proof:
0xfabfab...
Parent Proof:
0xf00baa...
TX: Mallory -> Bob

Blockchain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Insert
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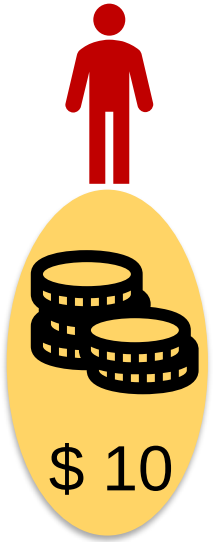
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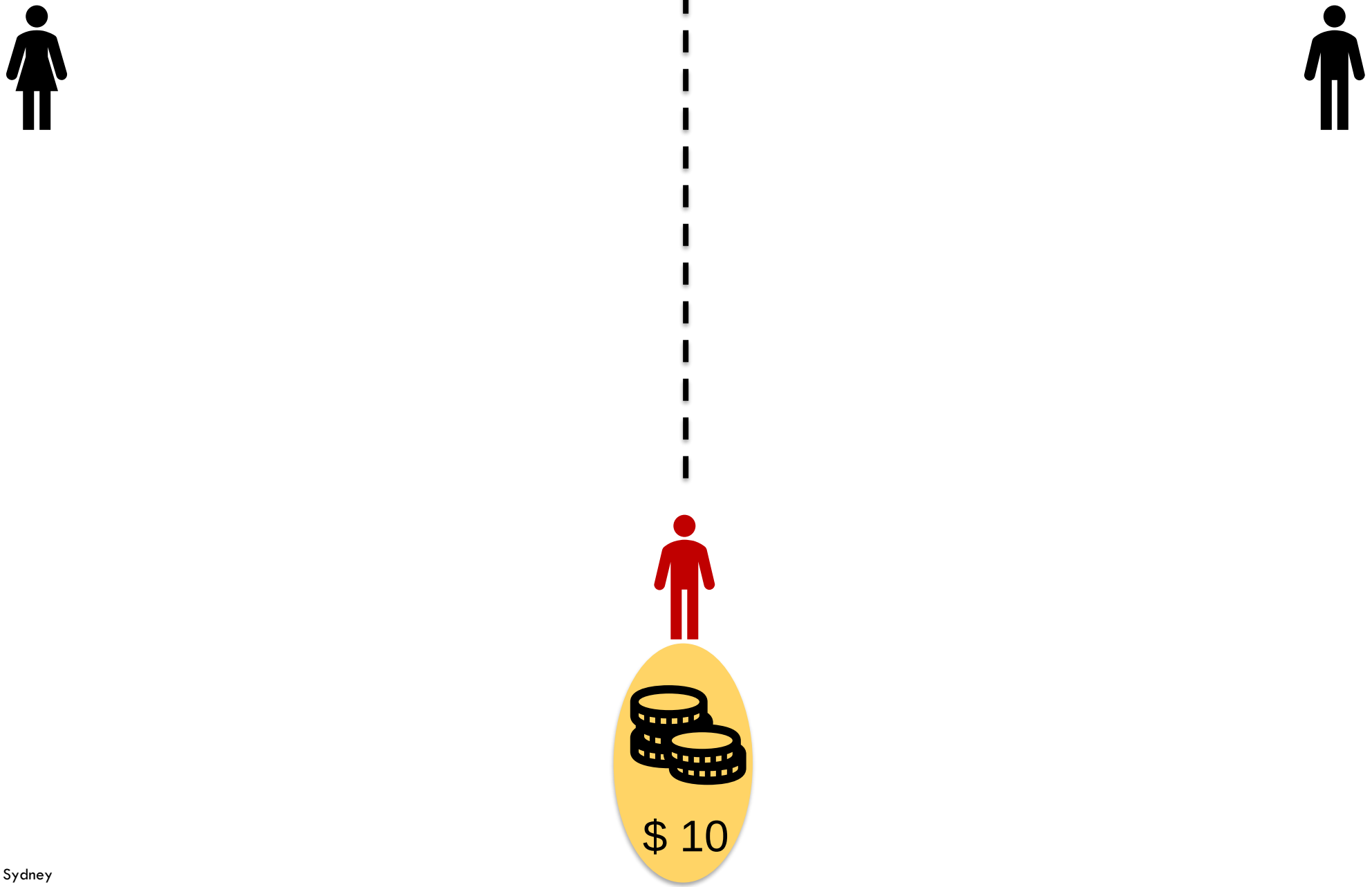
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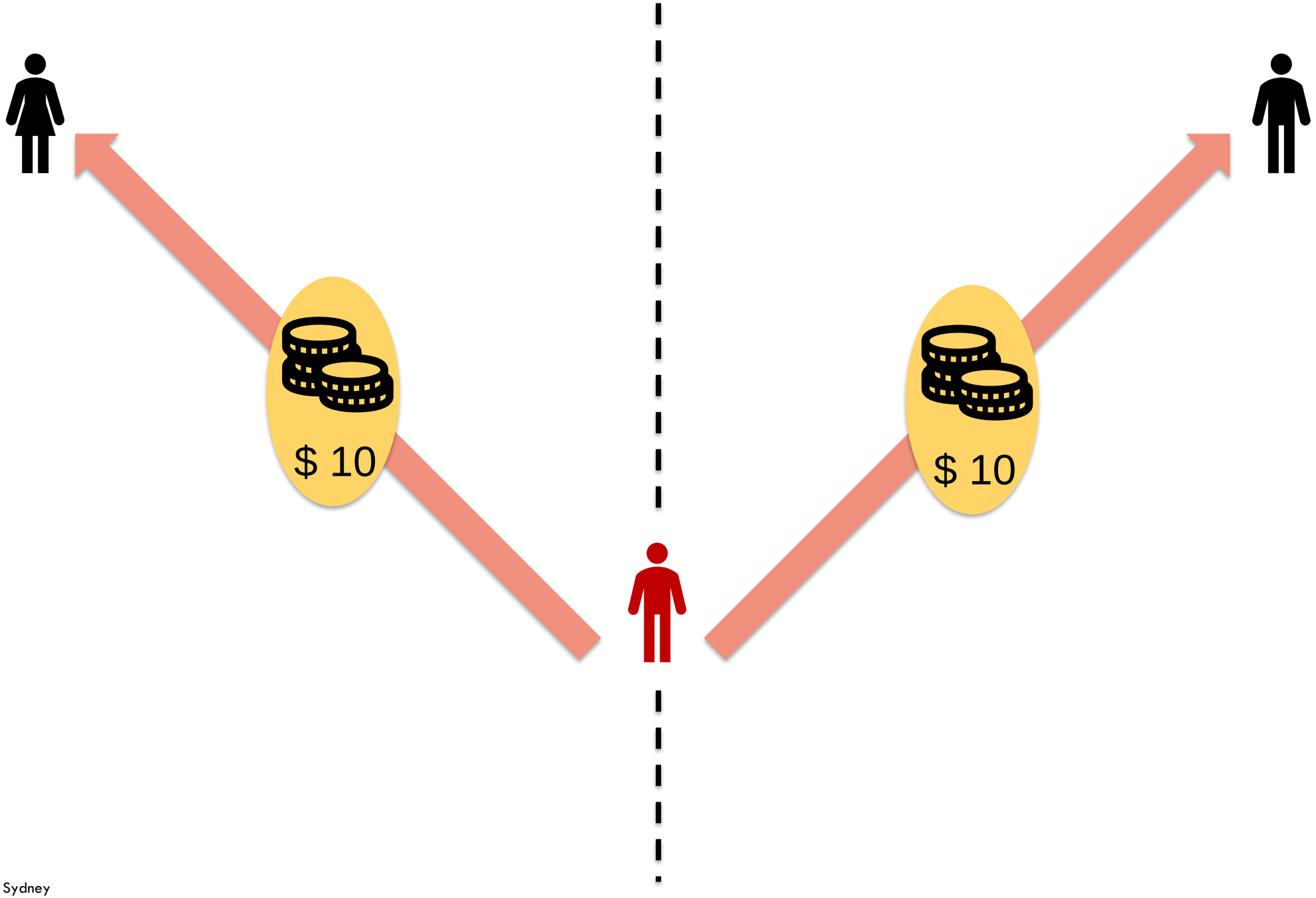
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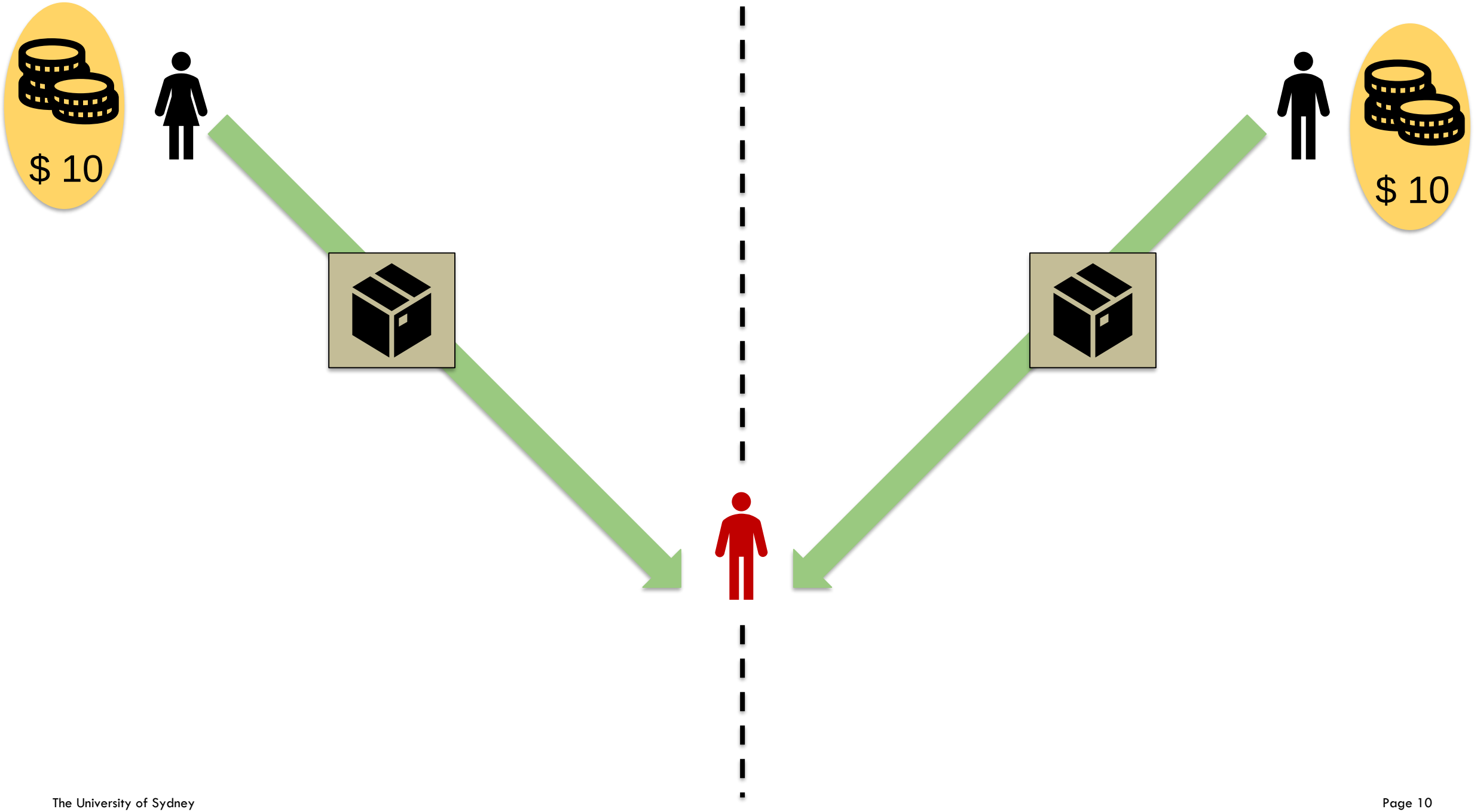
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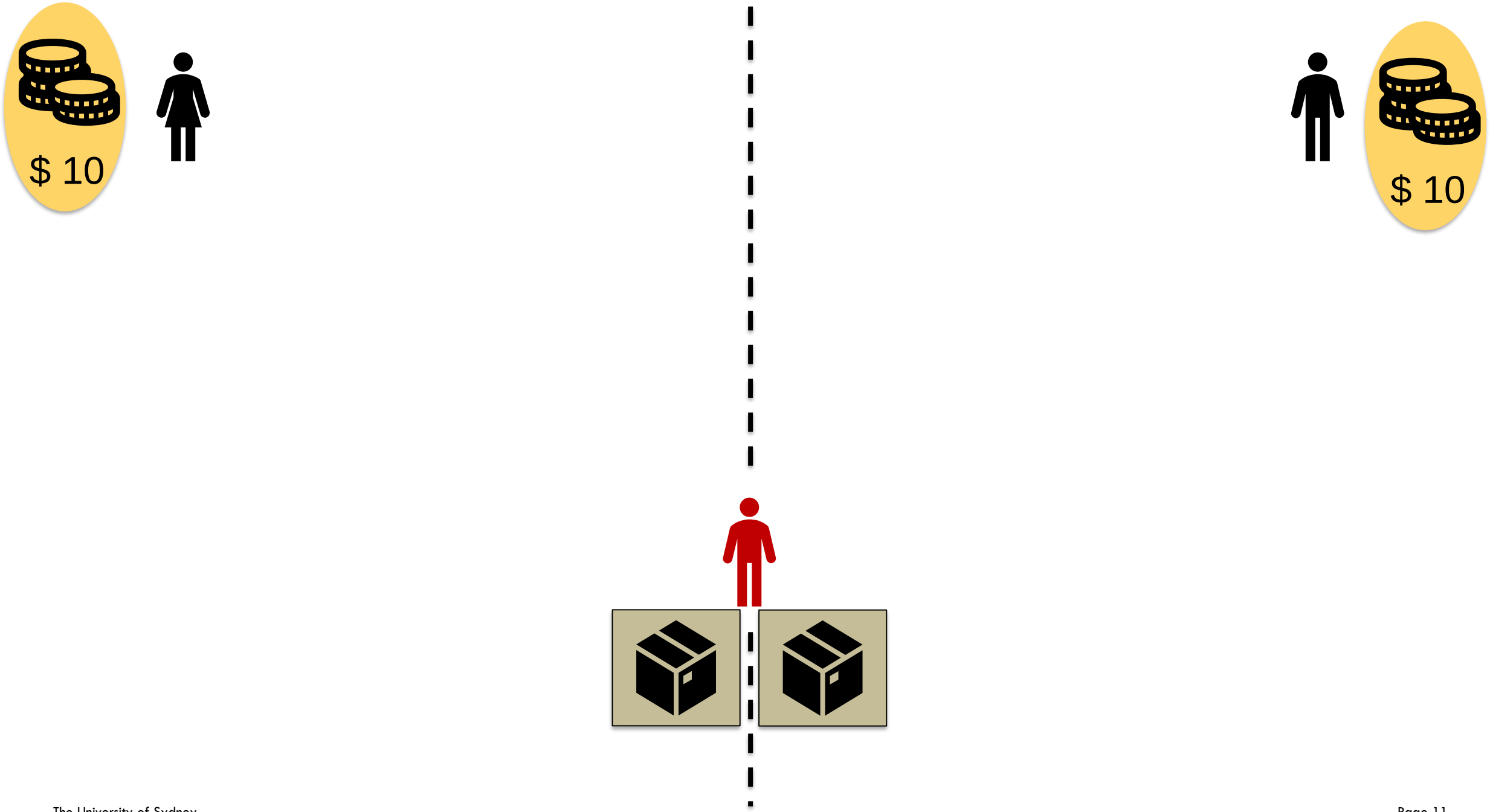
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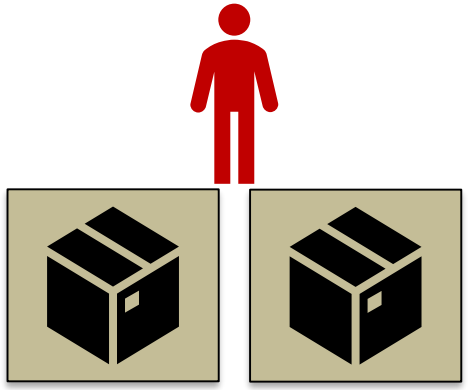


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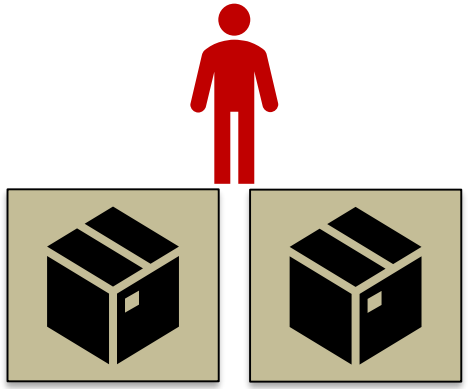

Q: is it possible to double spend on Ethereum with network attacks?

Approaches to study …

- Goals:
  1. How the blockchain system decide a block?
  2. How the blockchain system resolve fork?

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  1. How the blockchain system decide a block?
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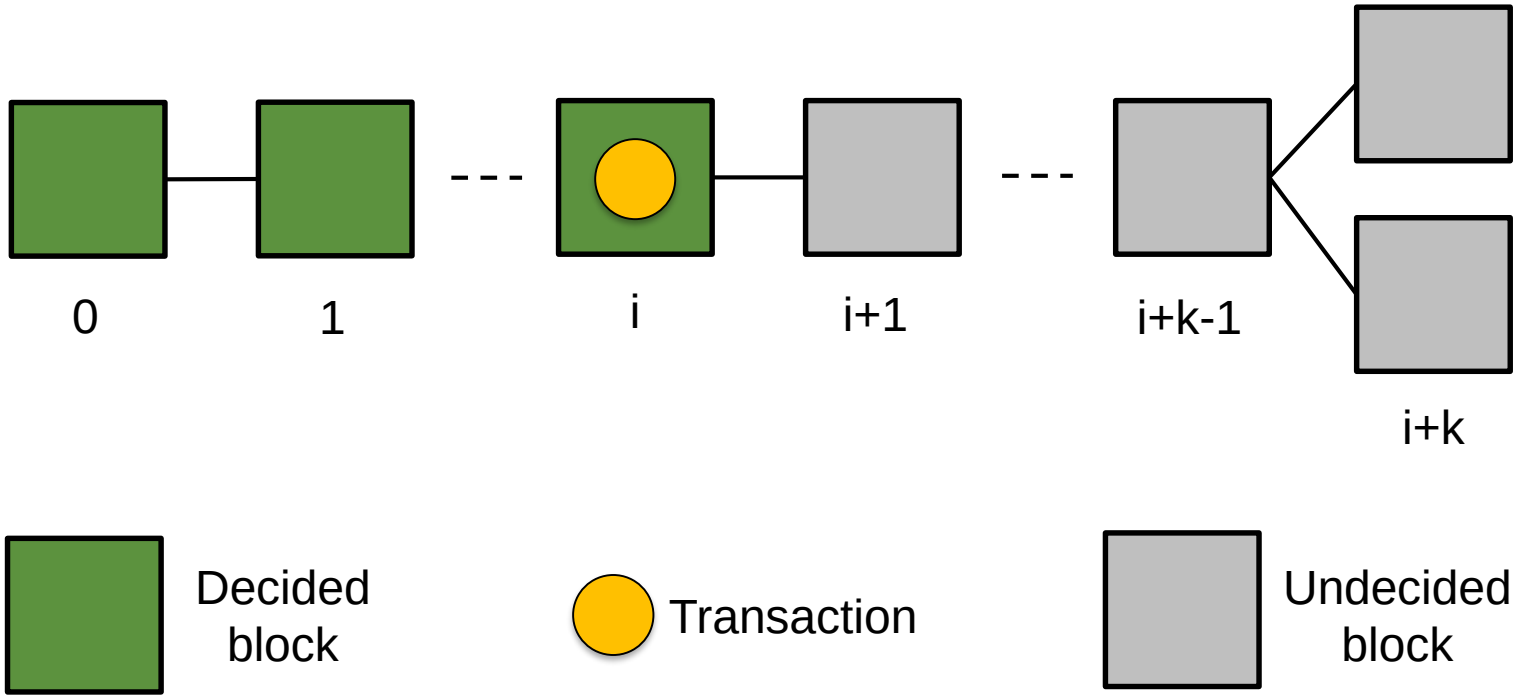
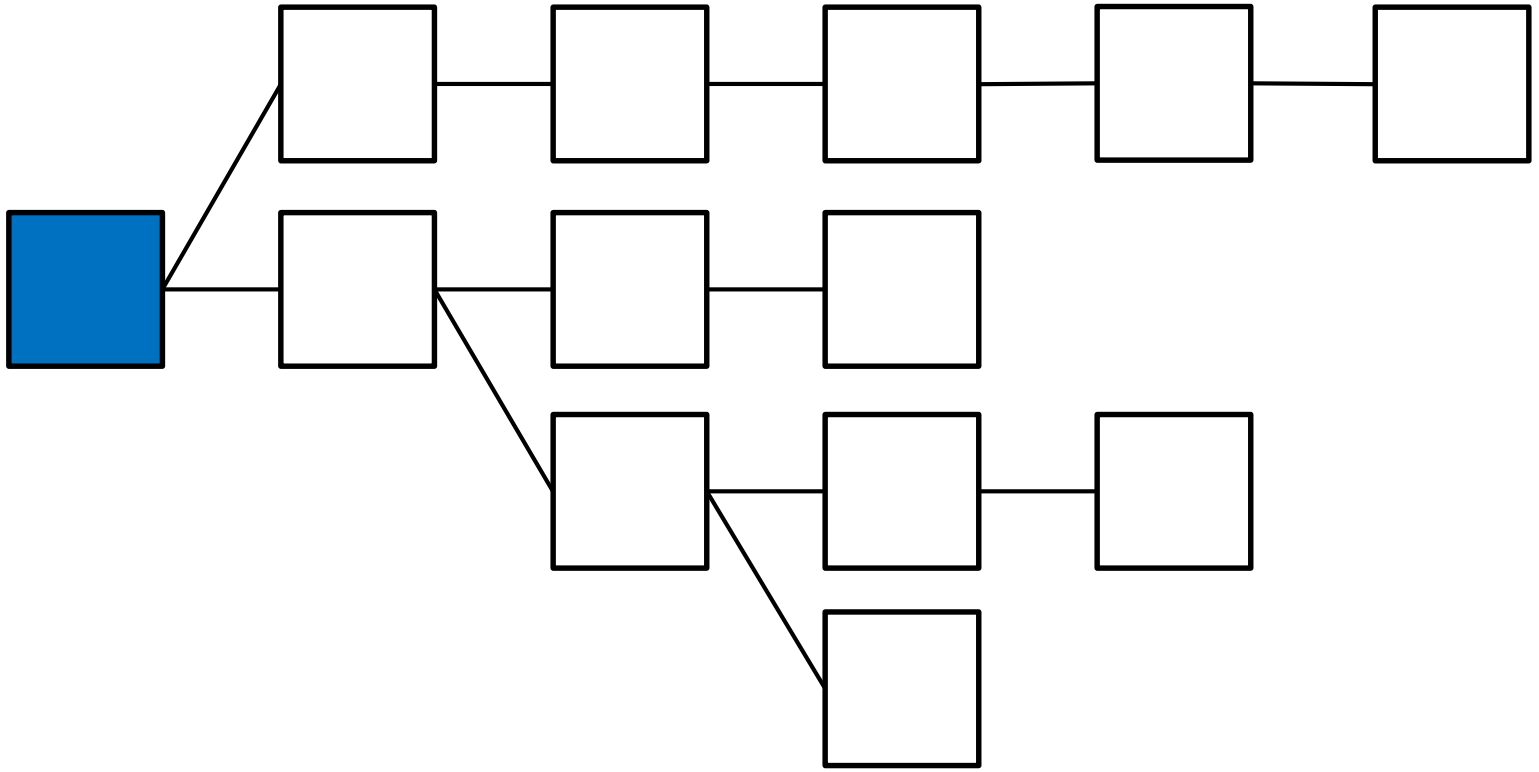
- Reading the documentation
  - Scattered and un-organised information:
    website, wiki, github, issue tracker, yellow paper ☺, etc.
  - Lack of necessary information
  - Intention ≠ Actual implementation
- Reading the code !!
- Running it for real because the devil is in the detail …

Decided Blocks and Committed Transactions in PoW/Ethereum

- Given a blockchain with parameter k, a block at index i is *decided* when the chain depth reaches i+k
- A transaction is *committed* if it belongs to a decided block



Expected Branch Selection in PoW/Ethereum: GHOST



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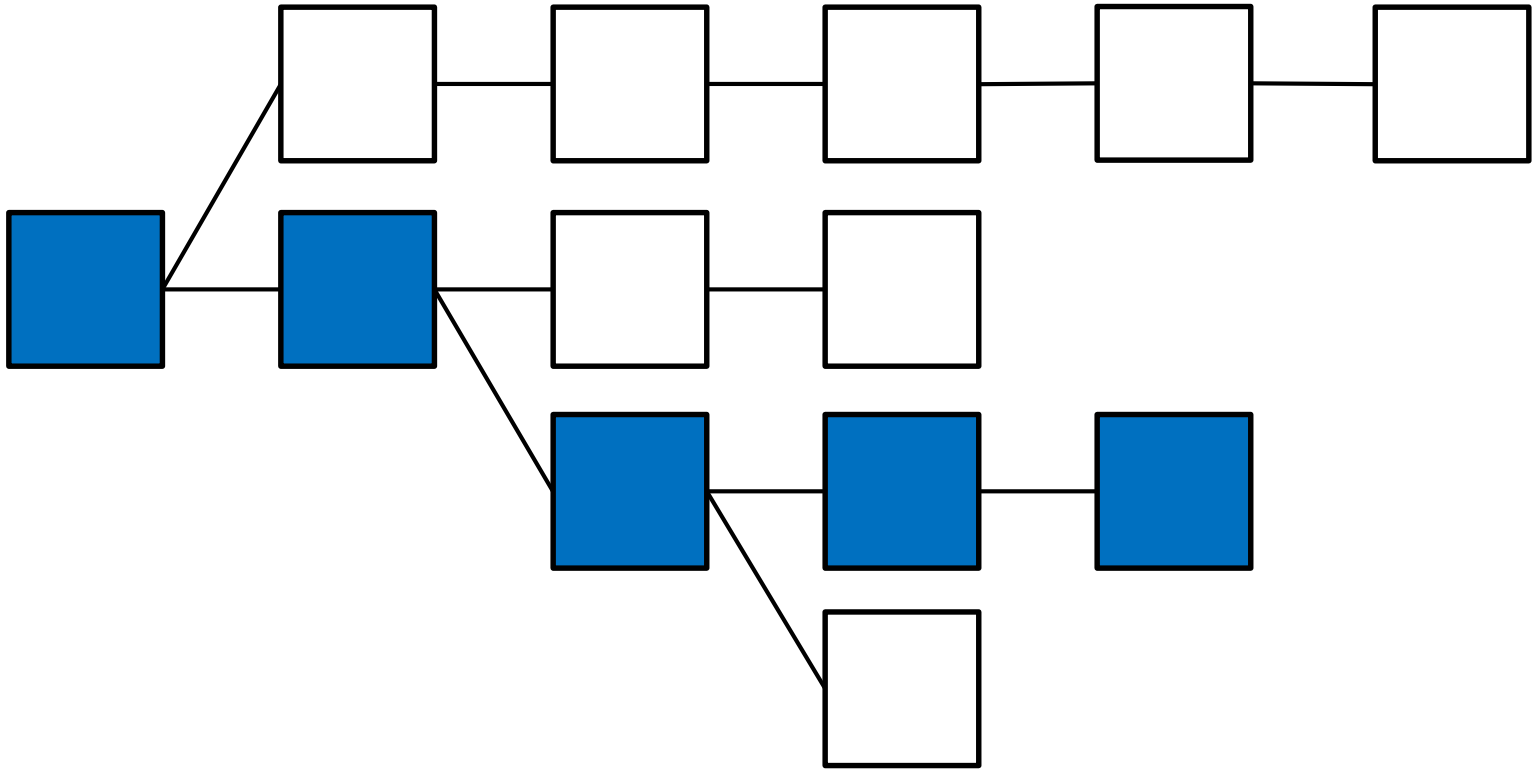
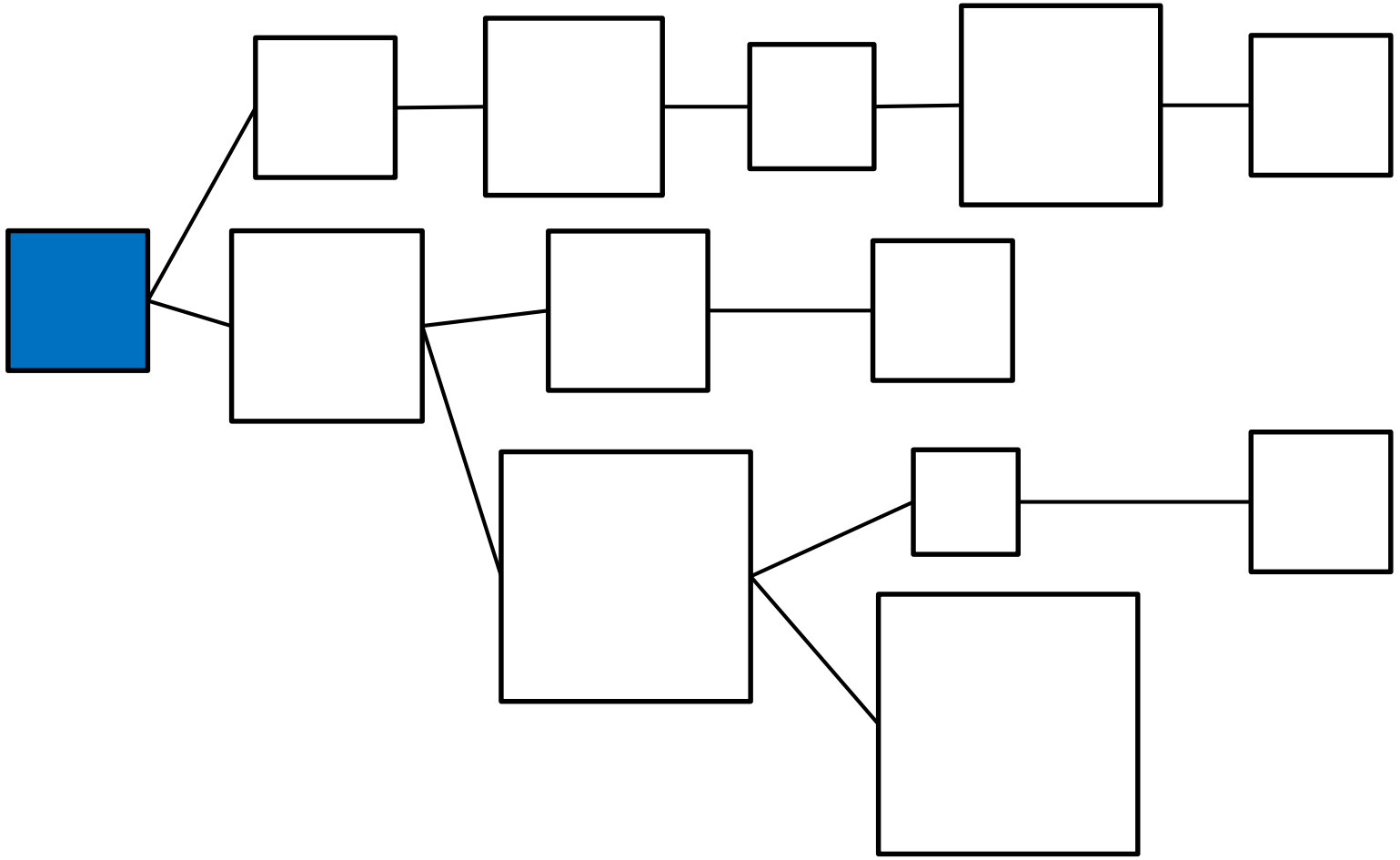


Actual Branch Selection in PoW/Ethereum: Highest total difficulty



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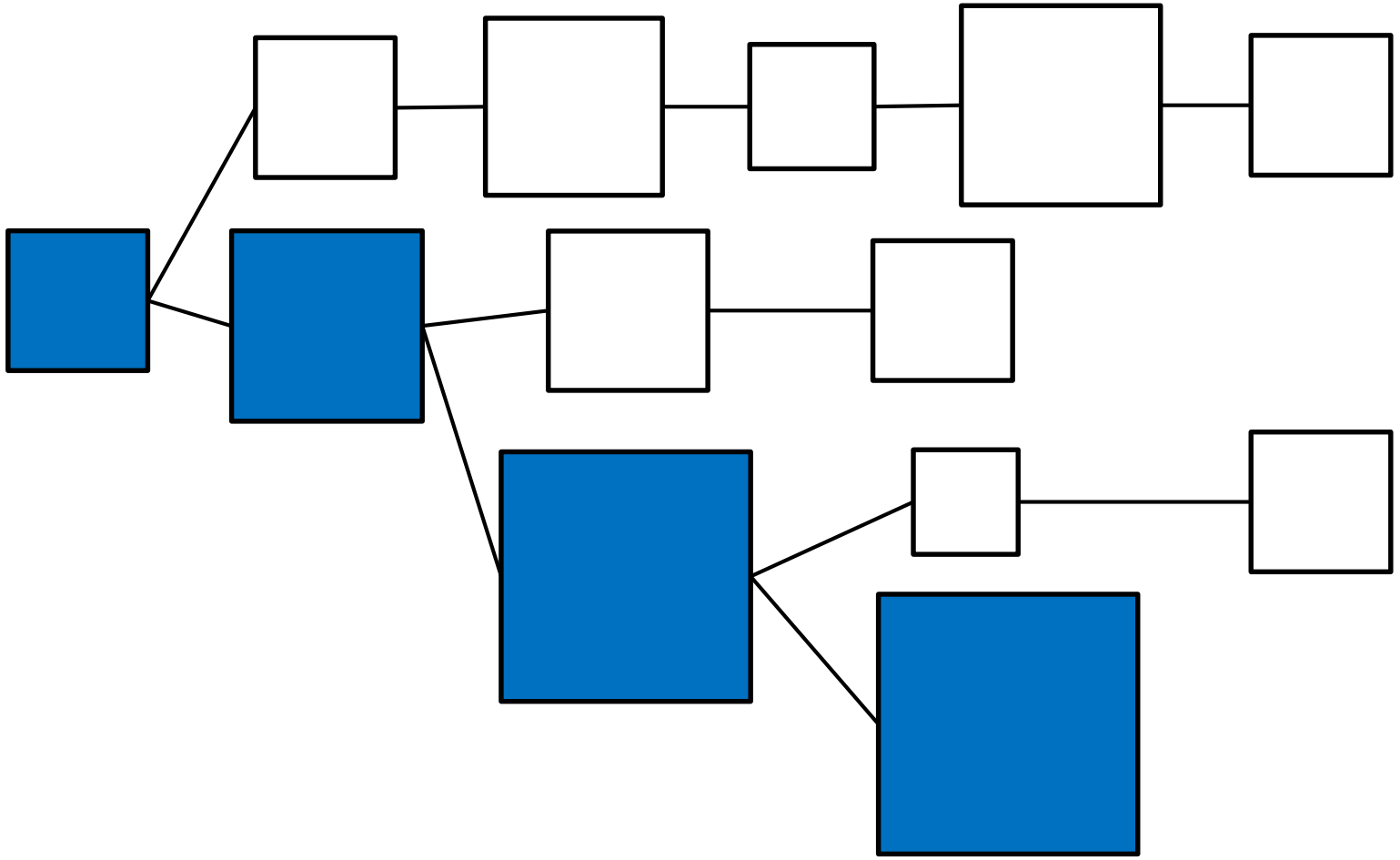
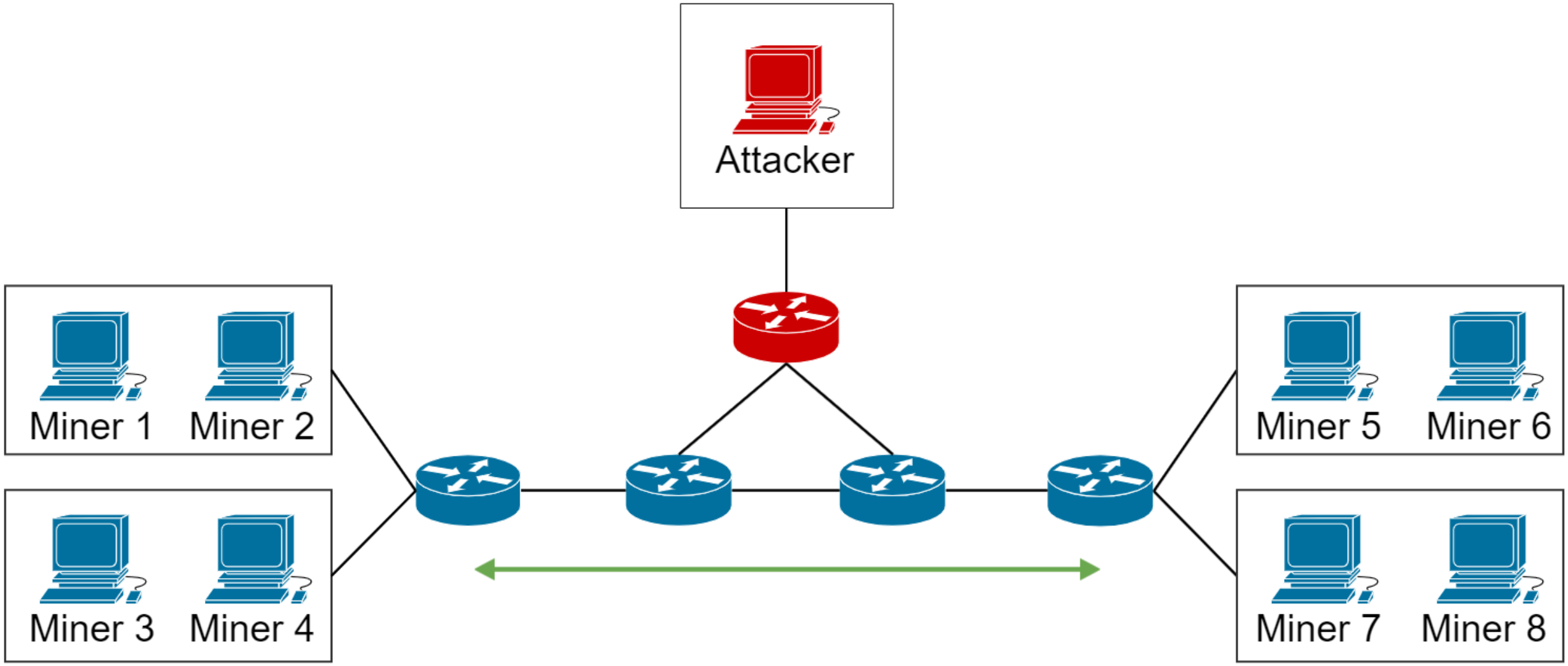


Example 1: Man-in-the-middle Attack aaainst PoW



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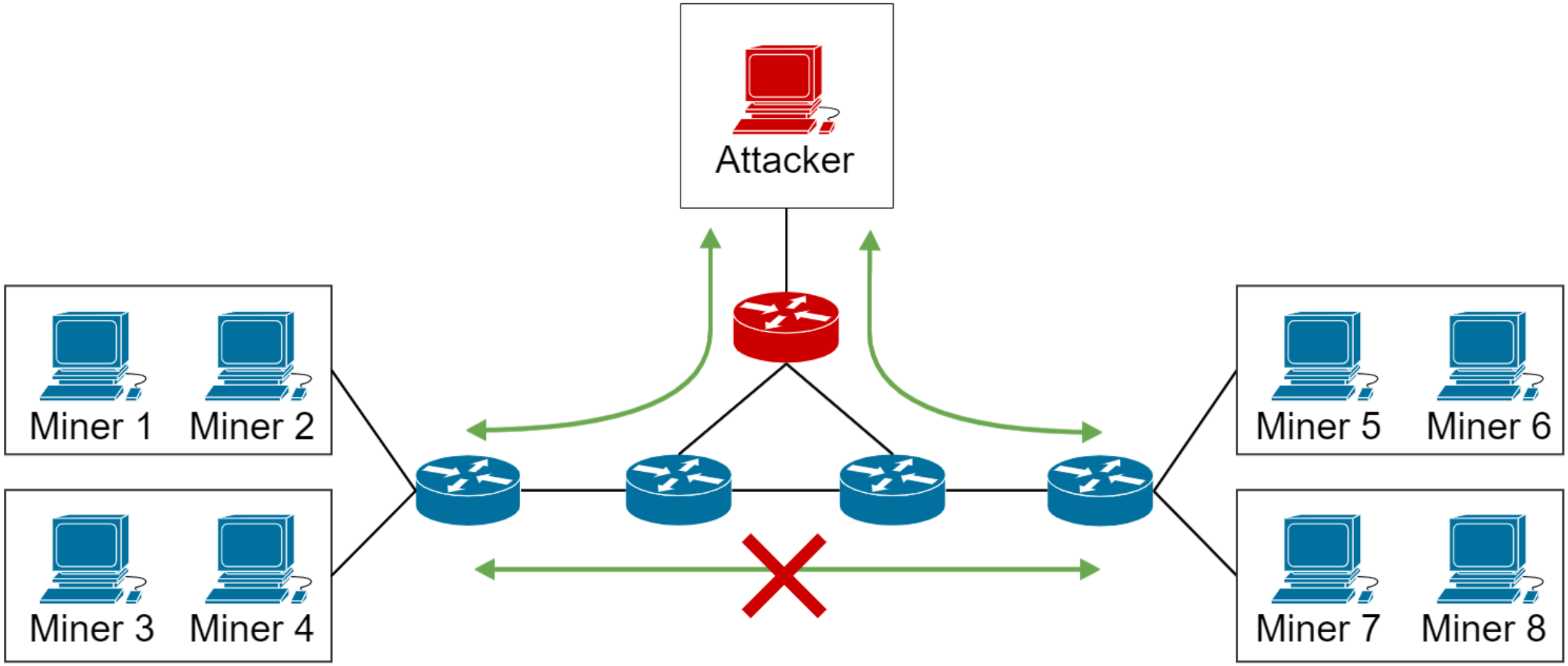

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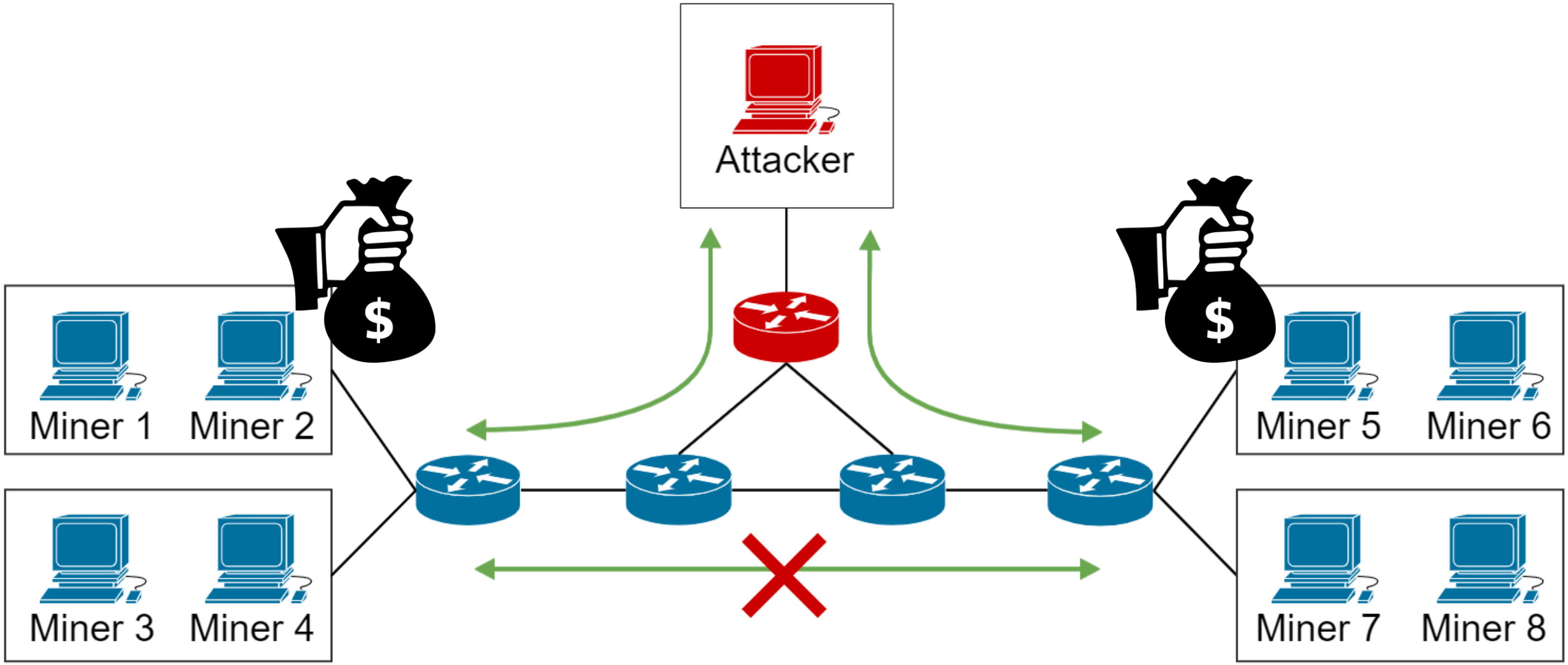

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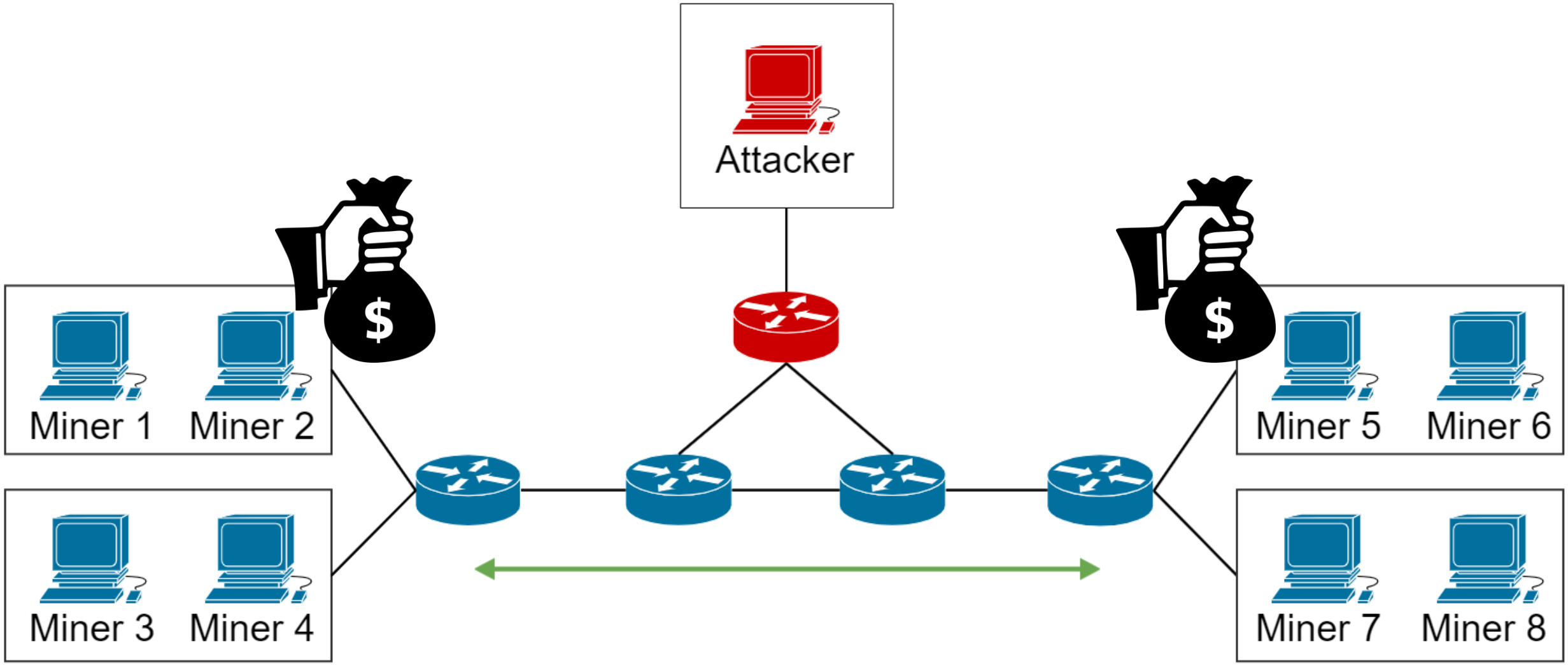

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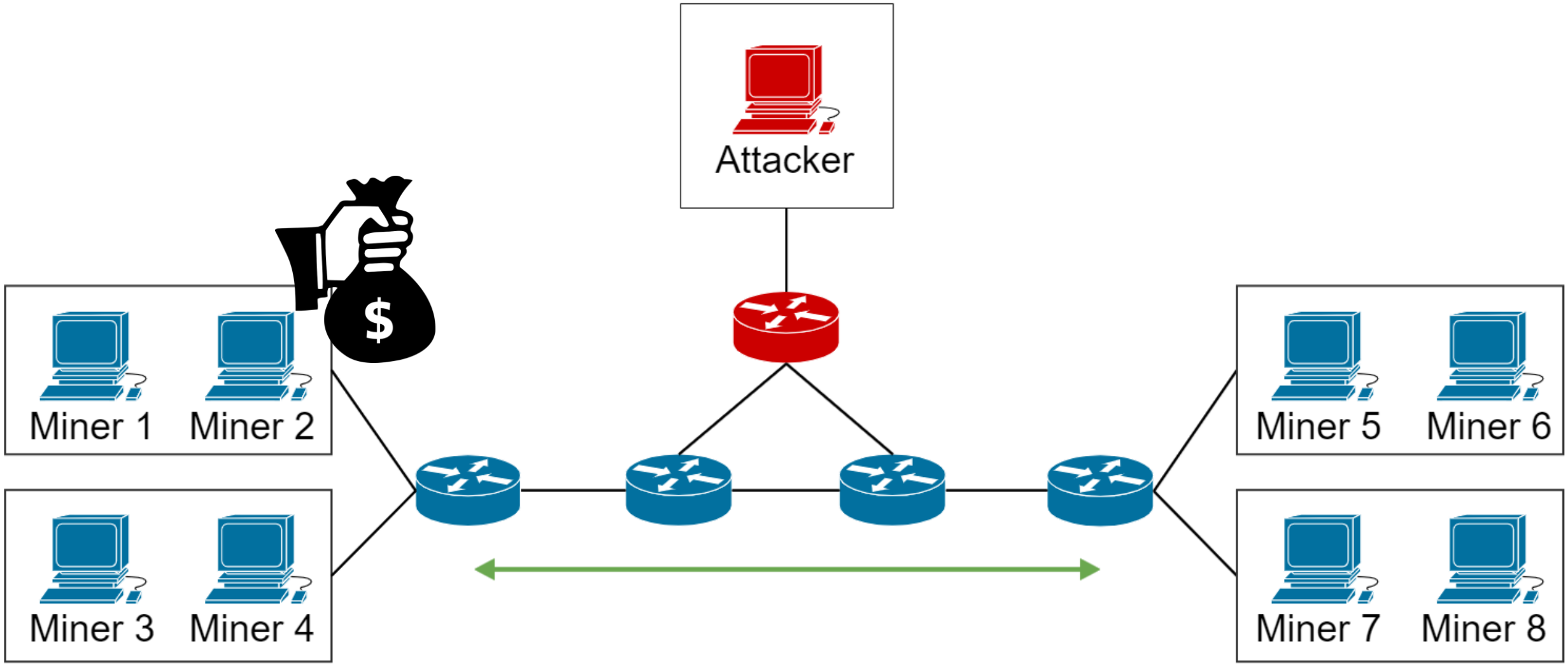
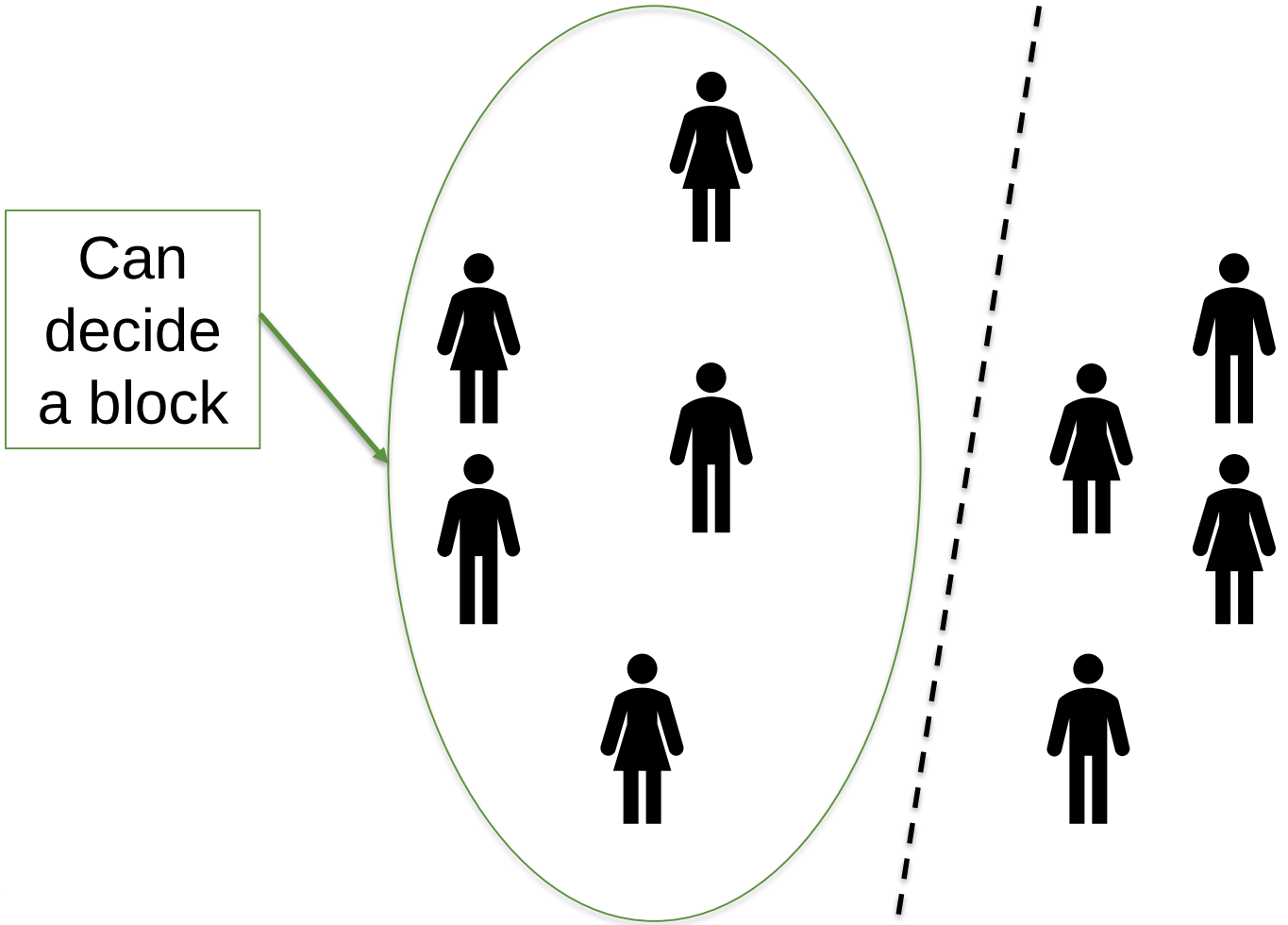
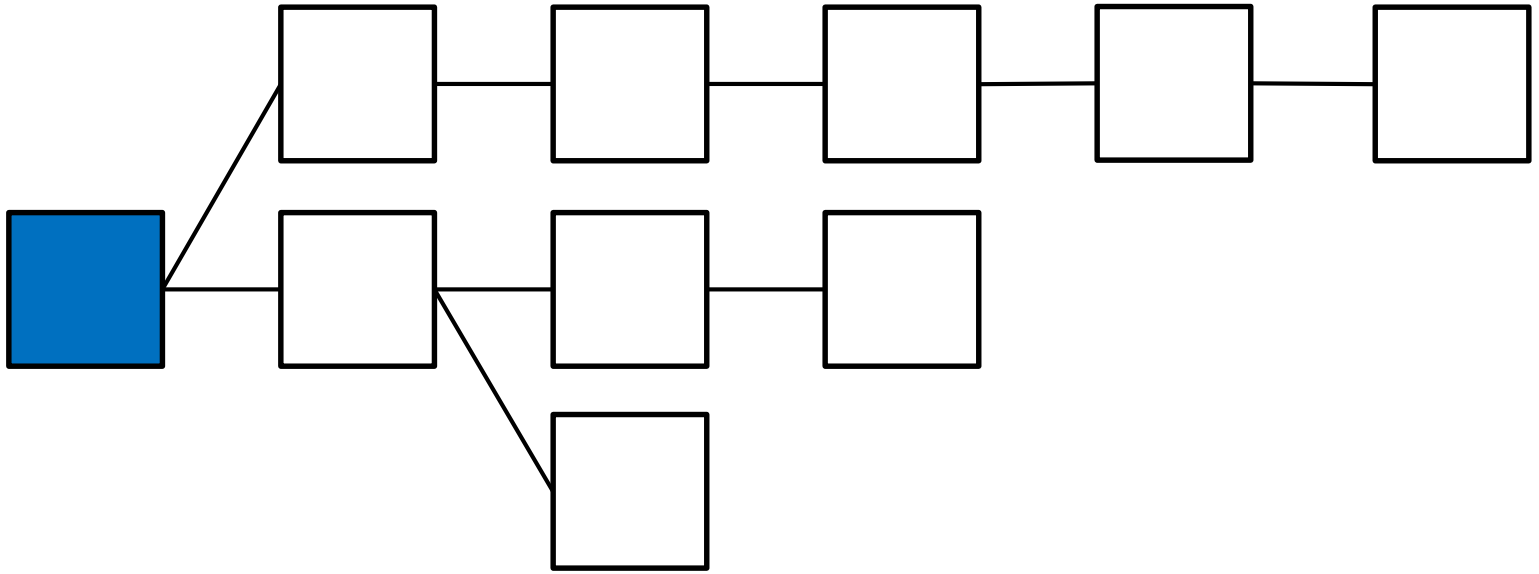


Decided Blocks and Committed Transactions in AuRa PoA/Ethereum

– A decision requires strictly more than half, only one partition may decide blocks



Branch Selection in AuRa PoA/Ethereum : Longest branch



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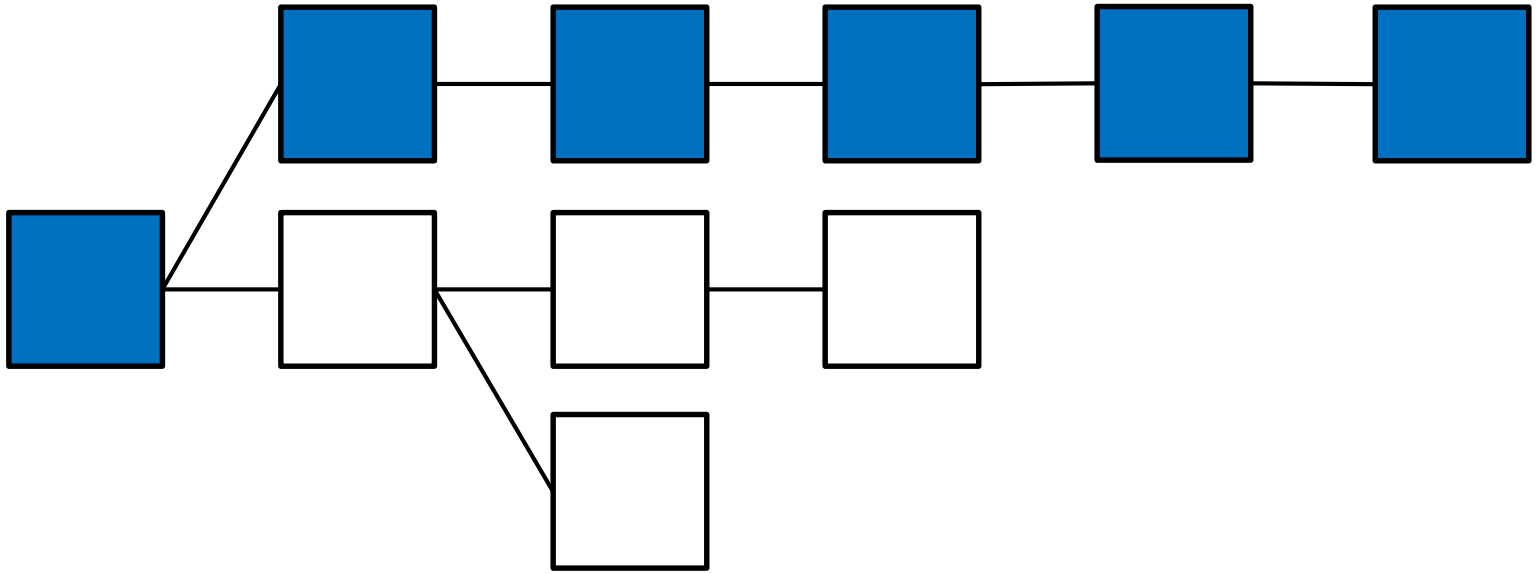
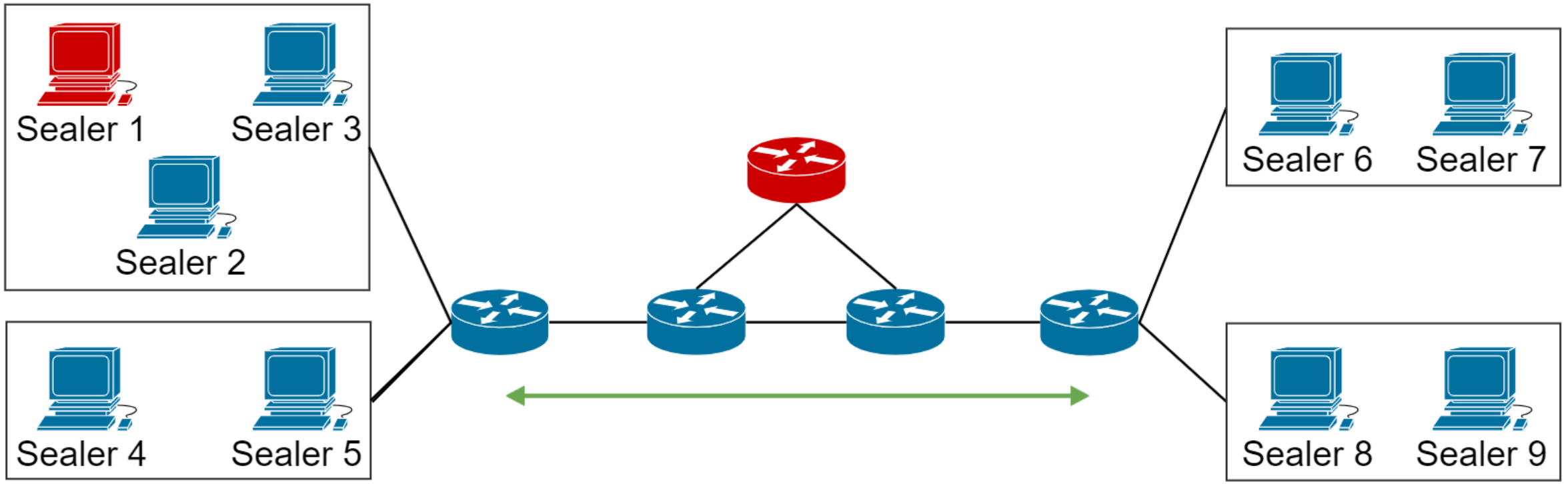


Example 2: The Cloning Attack against PoA



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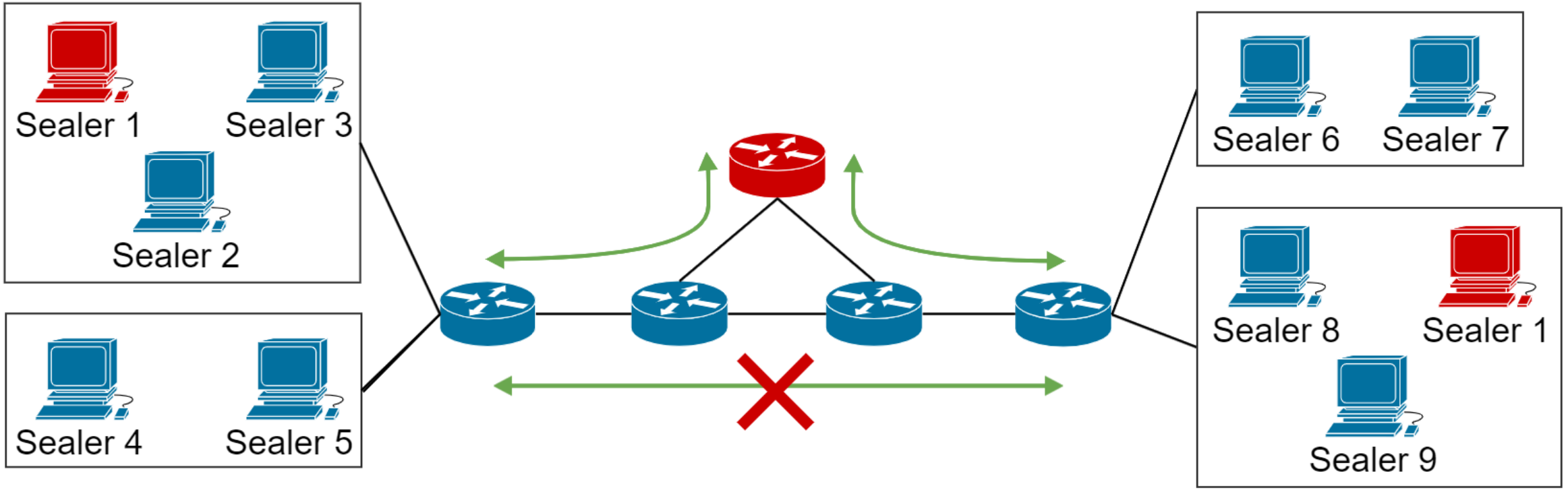

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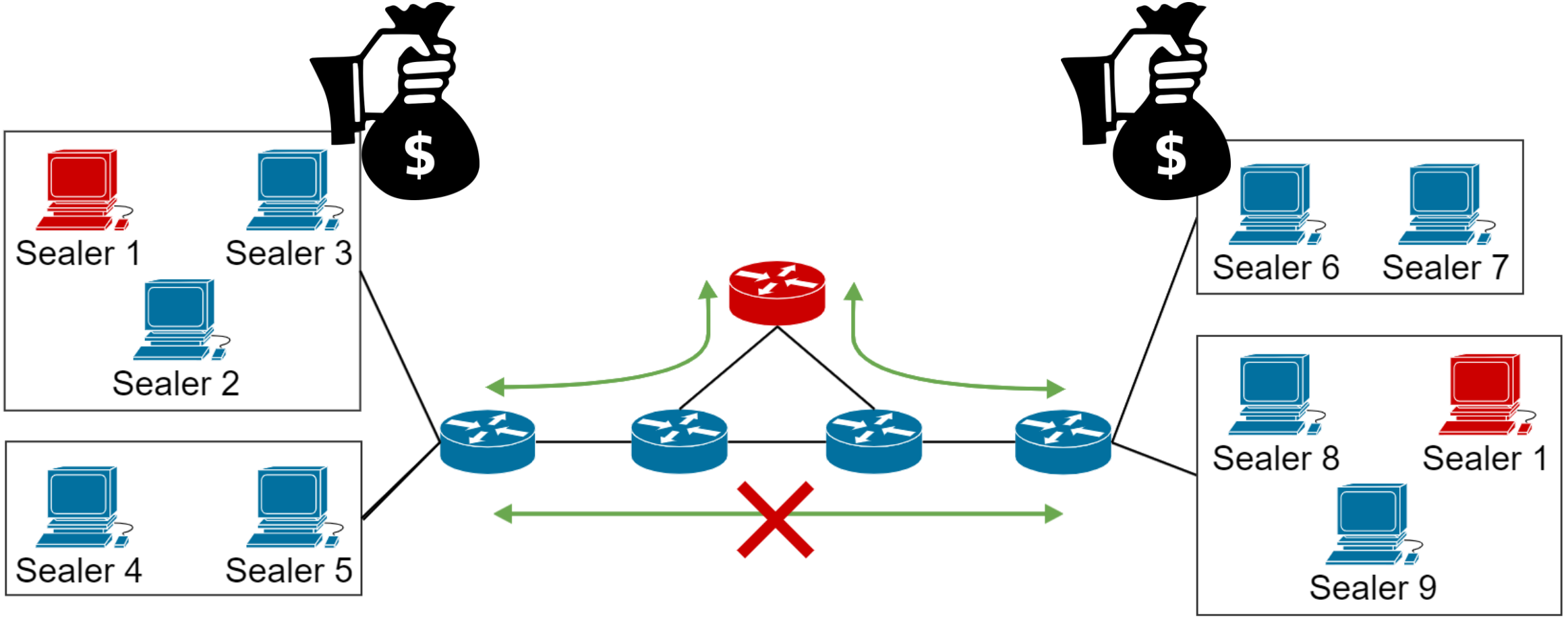

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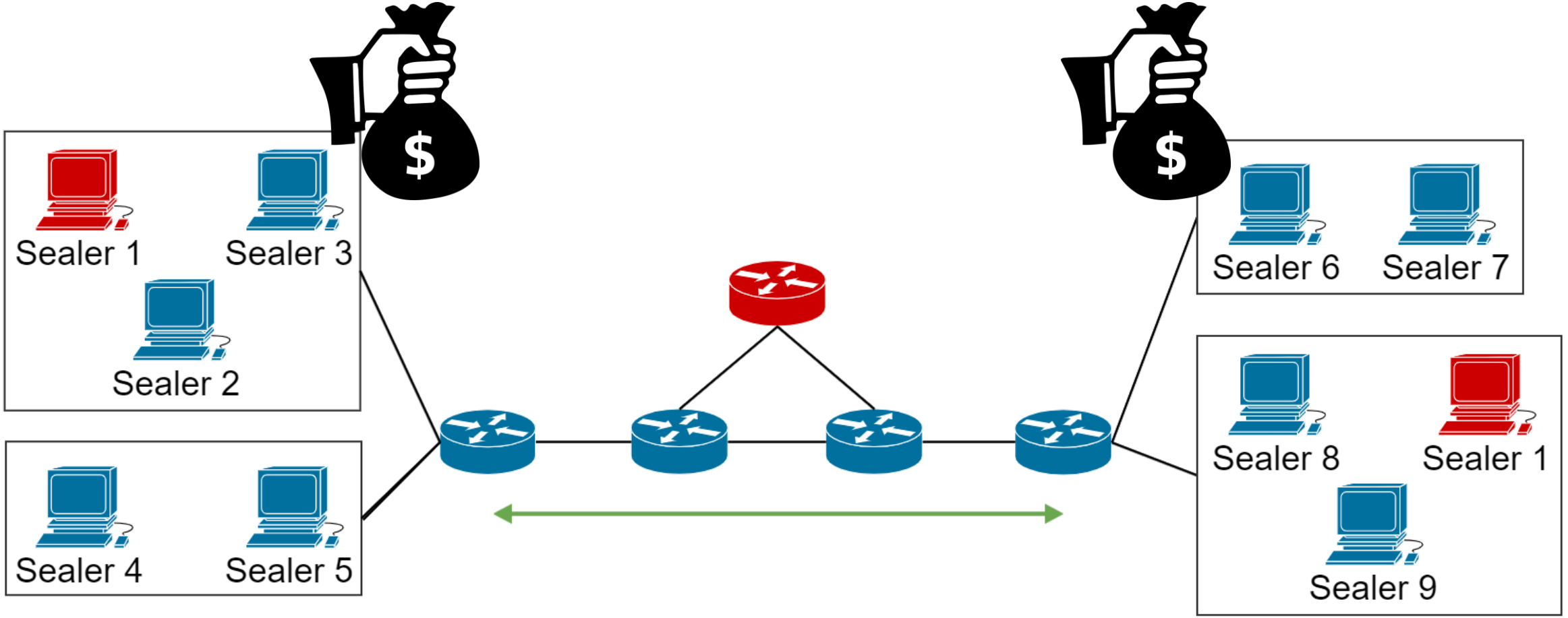

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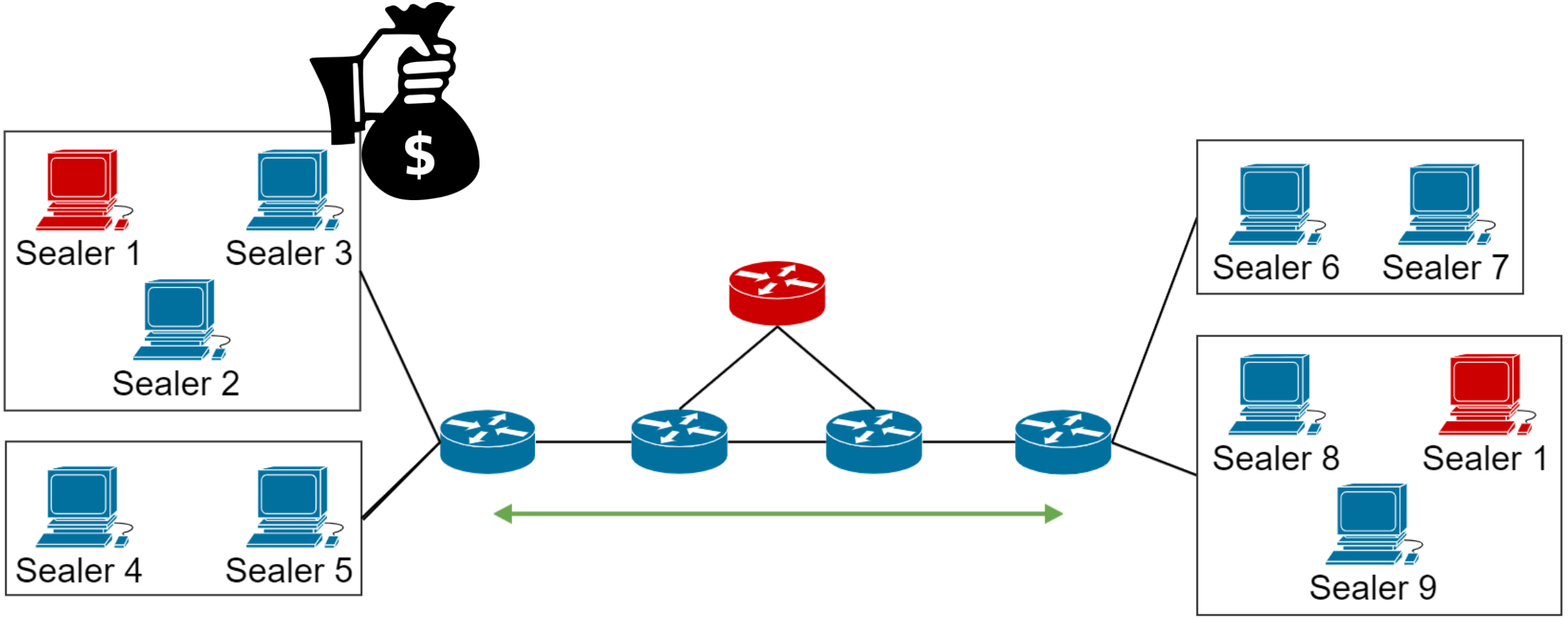
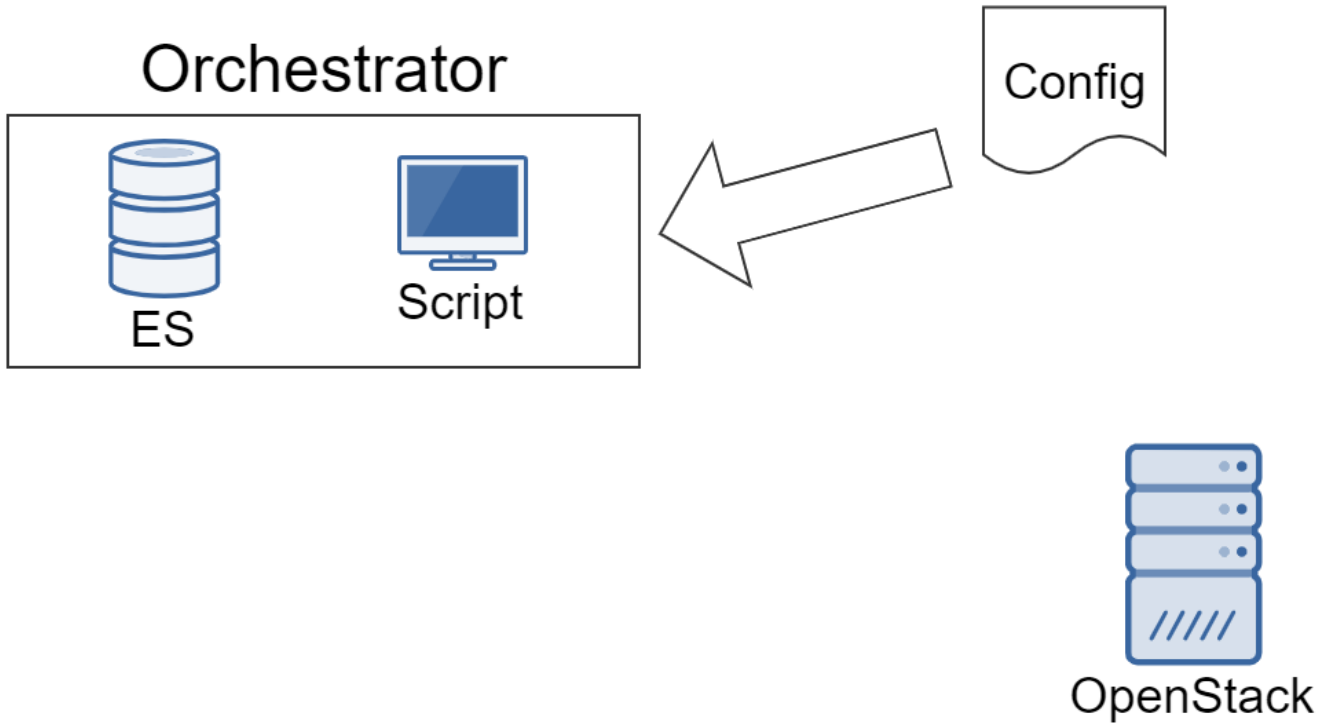


The requirements for the experiments

– Control over computing resources	➢ OpenStack Private Cloud
– Network control and isolation	➢ Virtual switches, Virtual routers (Quagga) and VLAN
– Highly automated	➢ OpenStack API and Ethereum API
– Robust data collection	➢ Elasticsearch

Testbed Provisioning



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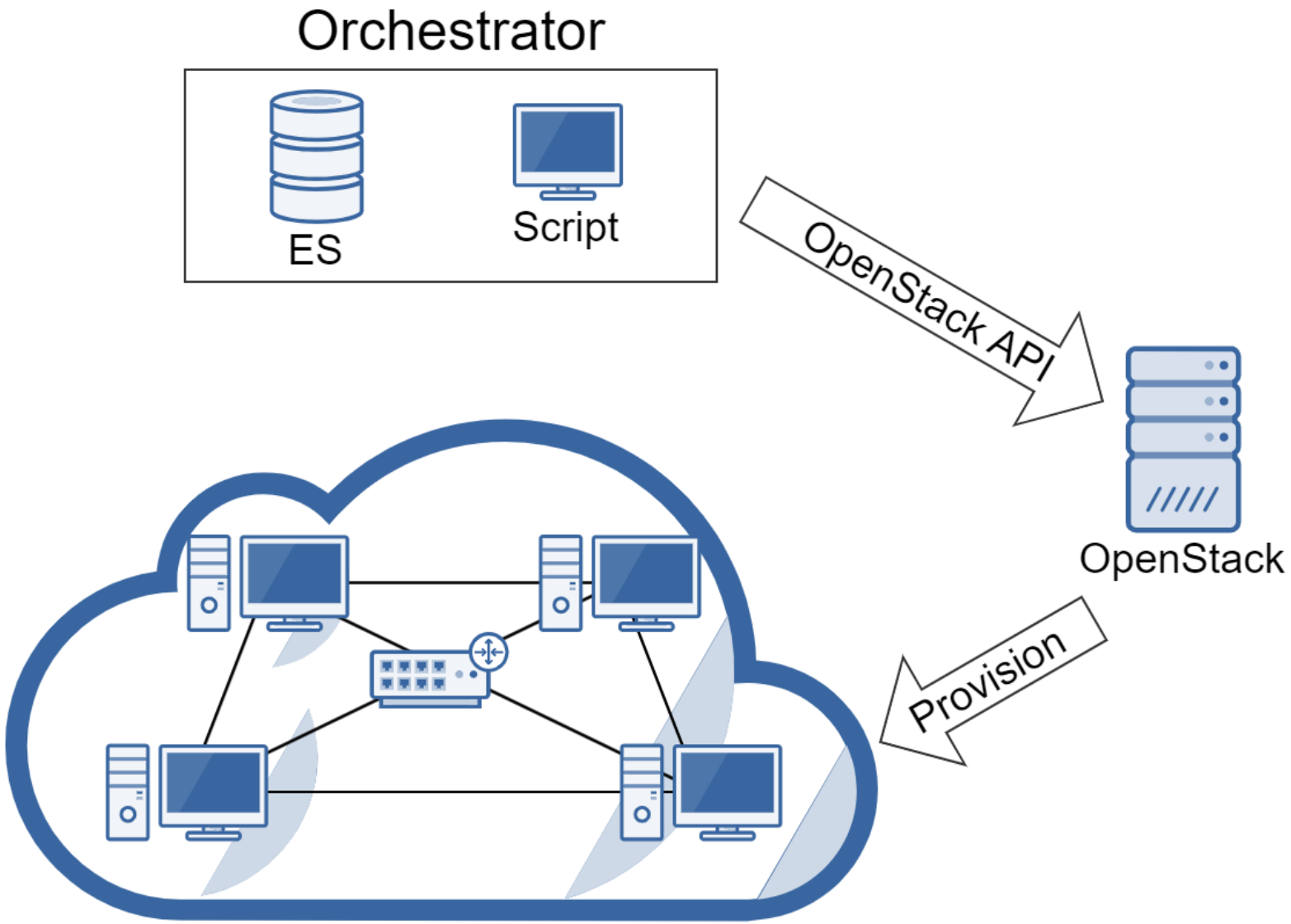

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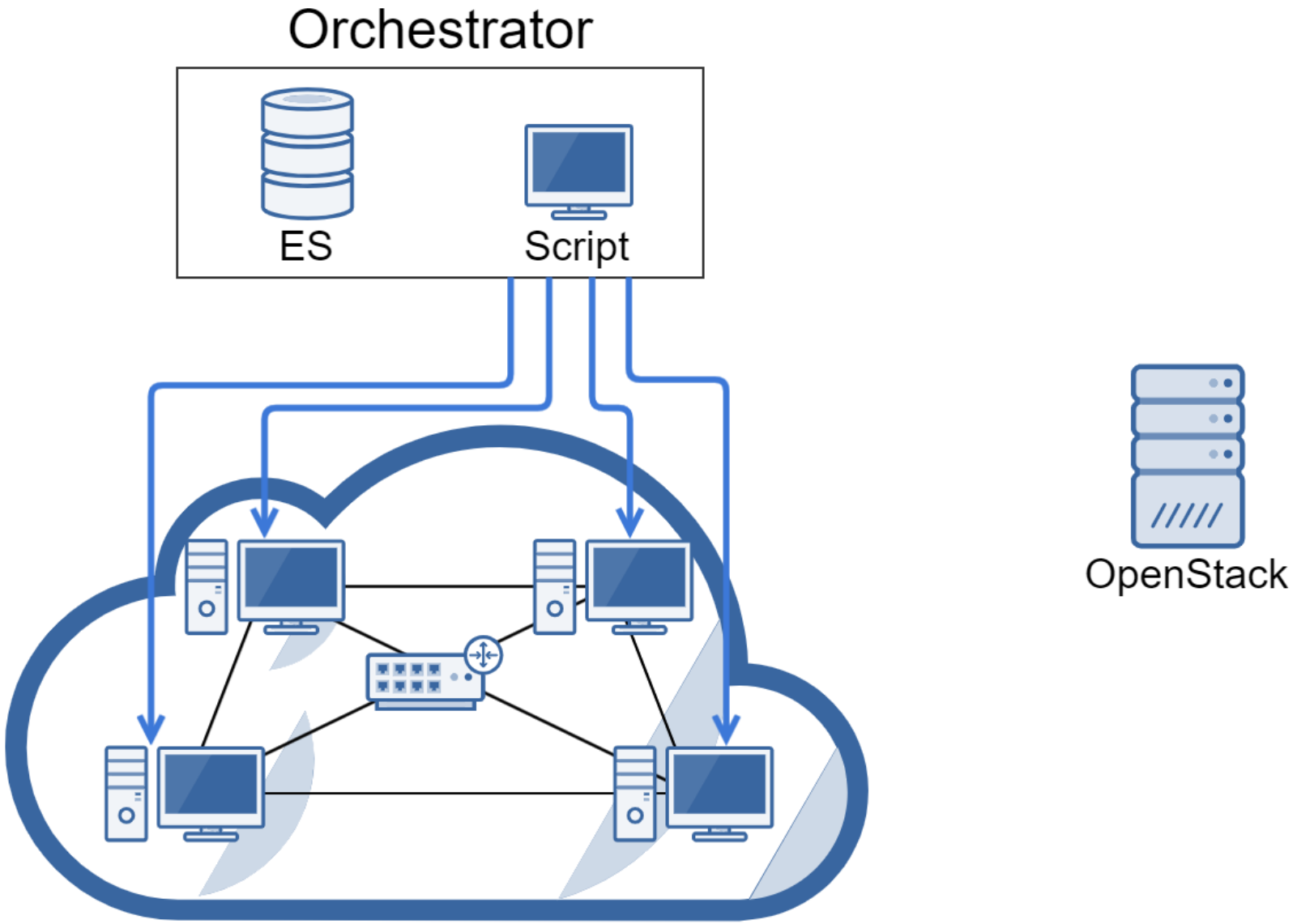

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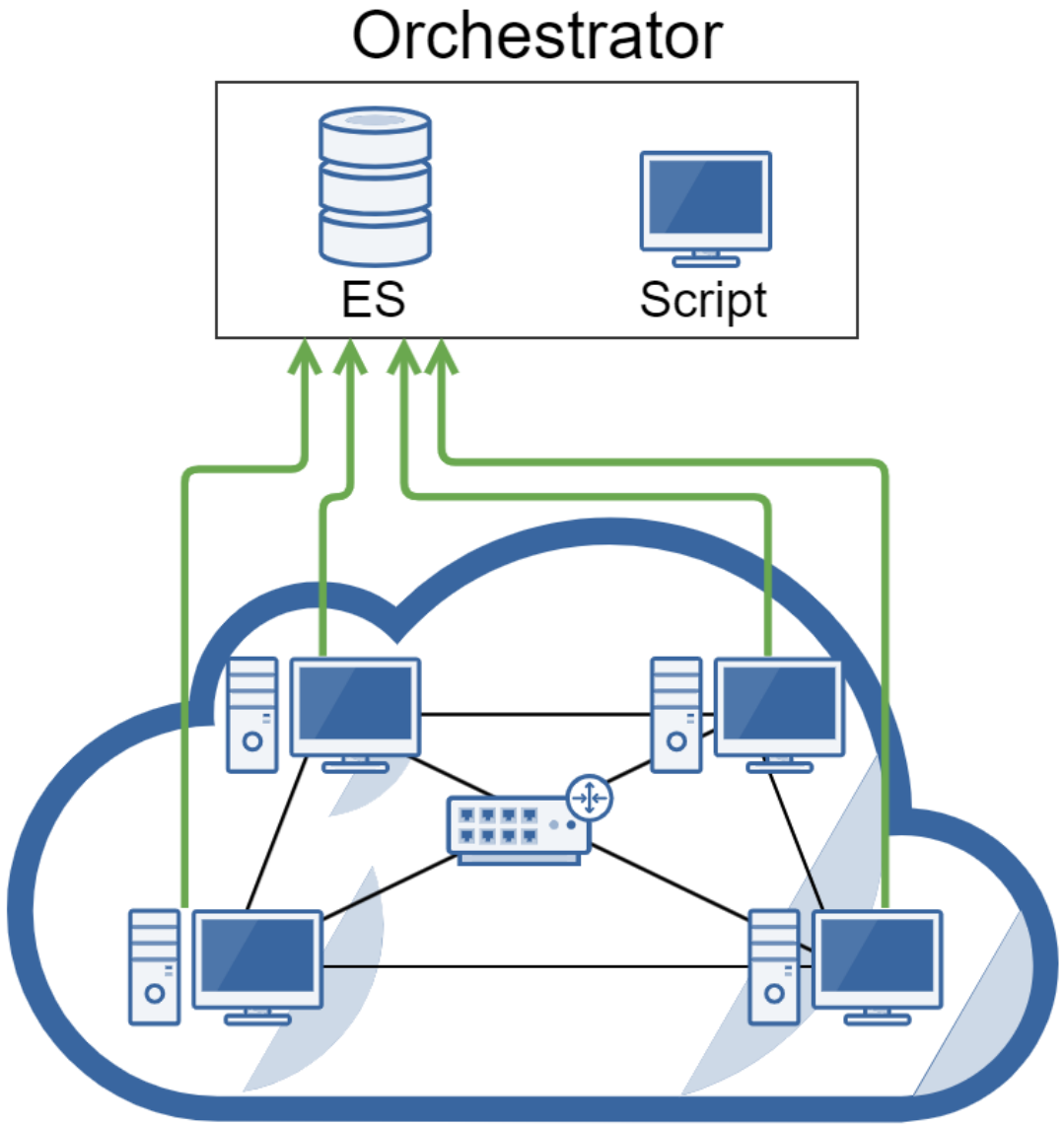

Time for Discussions !!

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