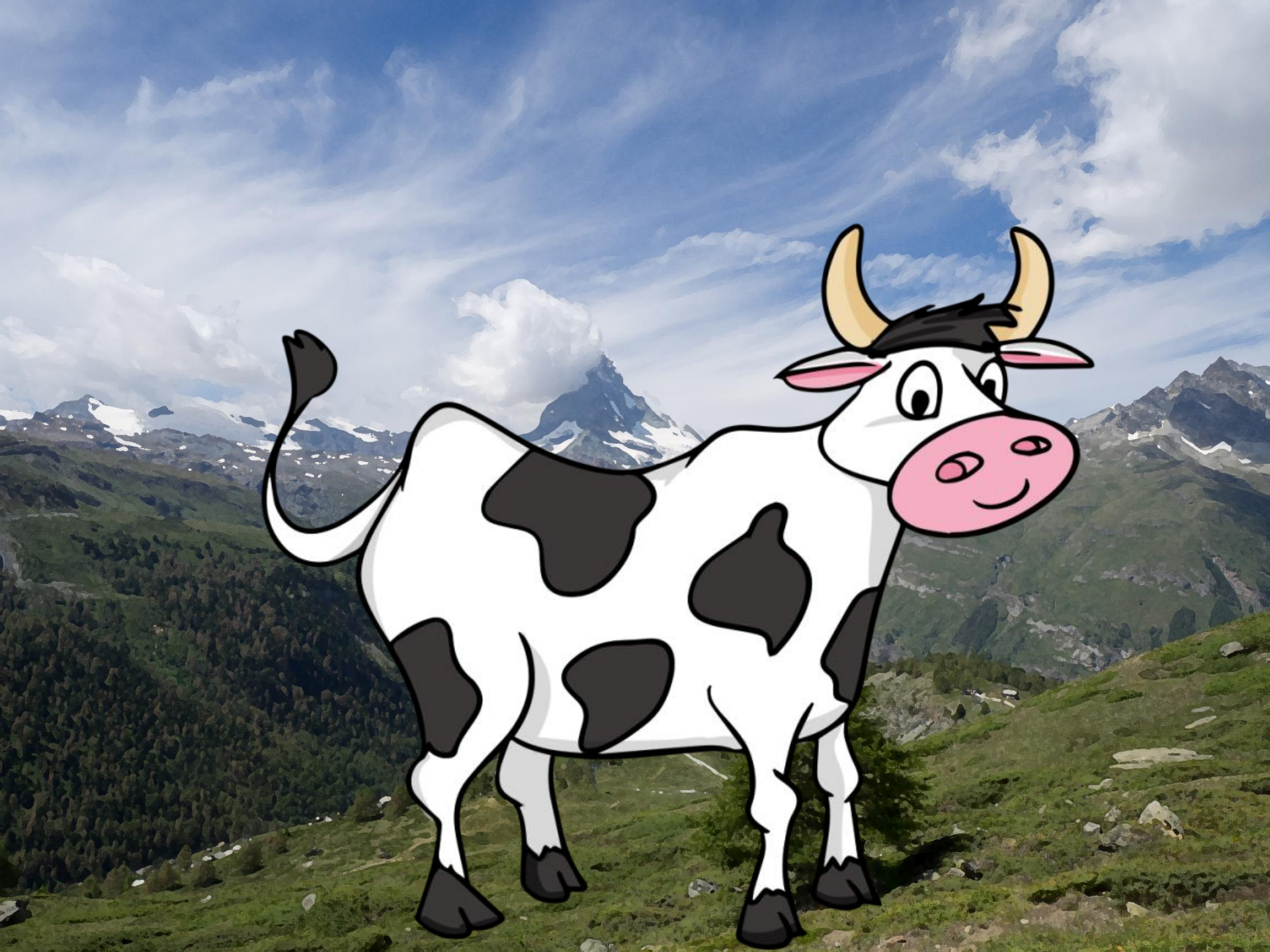
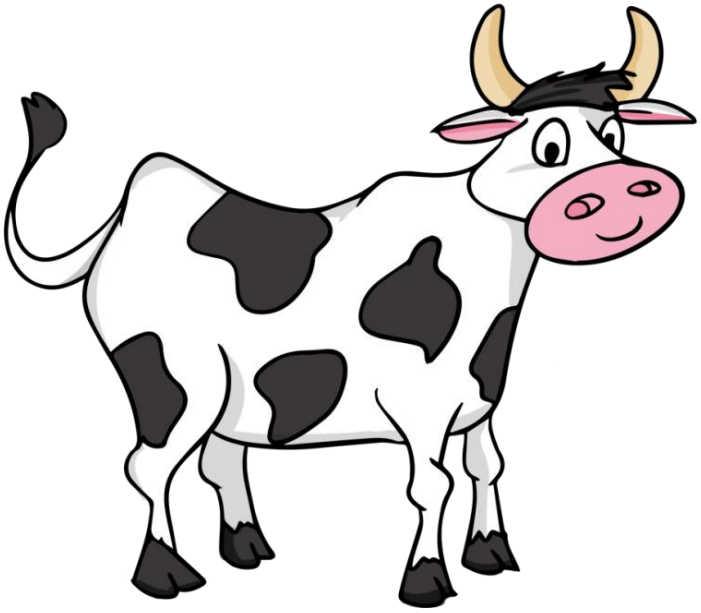
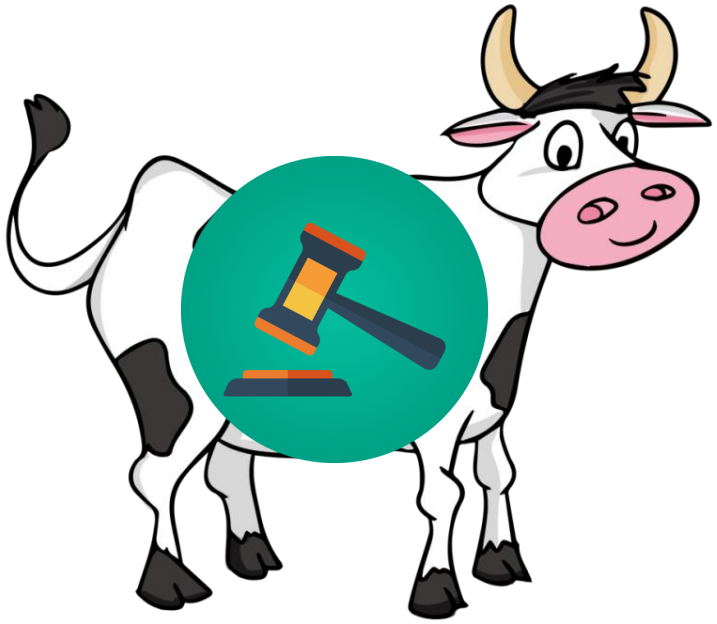
Byzantine Agreement with Interval Validity

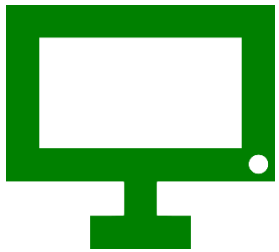
Darya Melnyk and Roger Wattenhofer

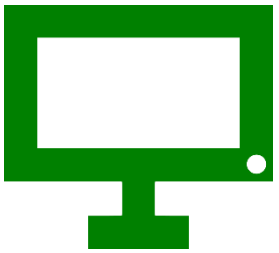


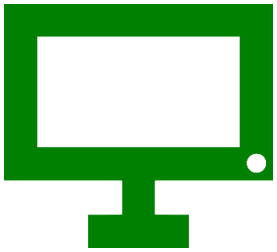


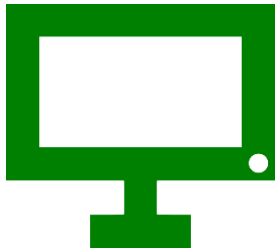
Distributed Auction

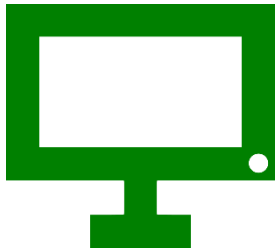


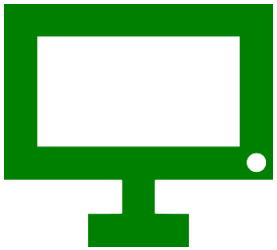


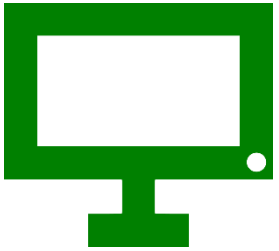




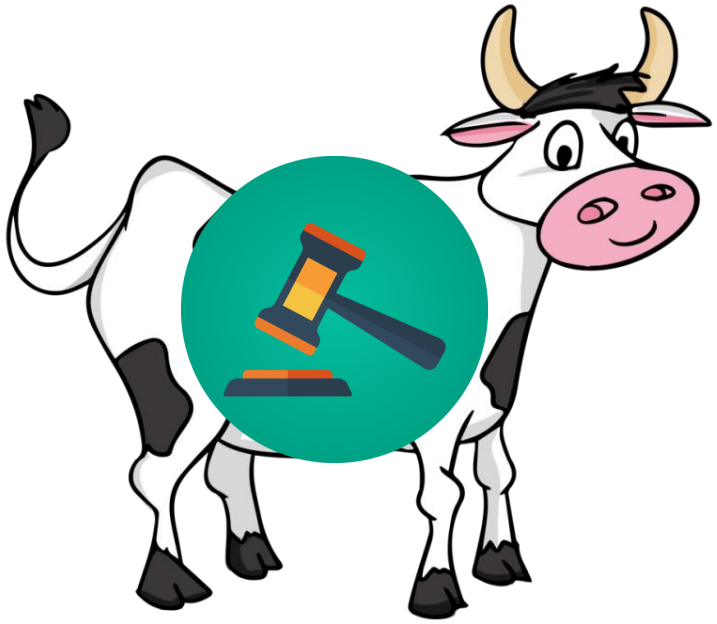








Distributed Auction



1500$

1250$

1350$

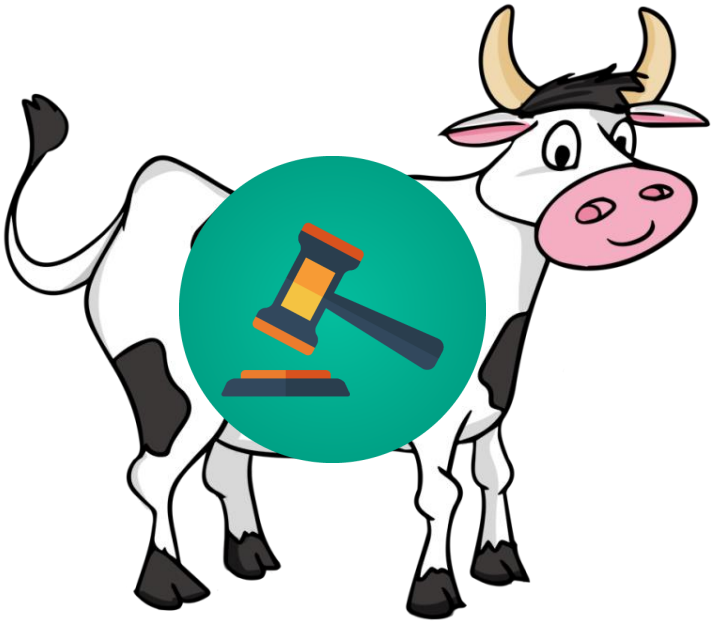
20$

1200$

1000$

2000$

Distributed Auction



1500$

1250$

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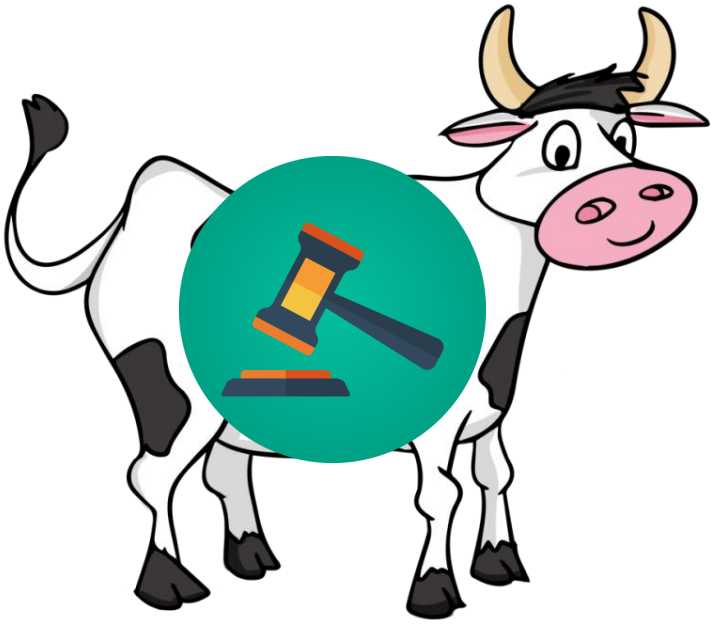
Distributed Auction



1500$

1250$

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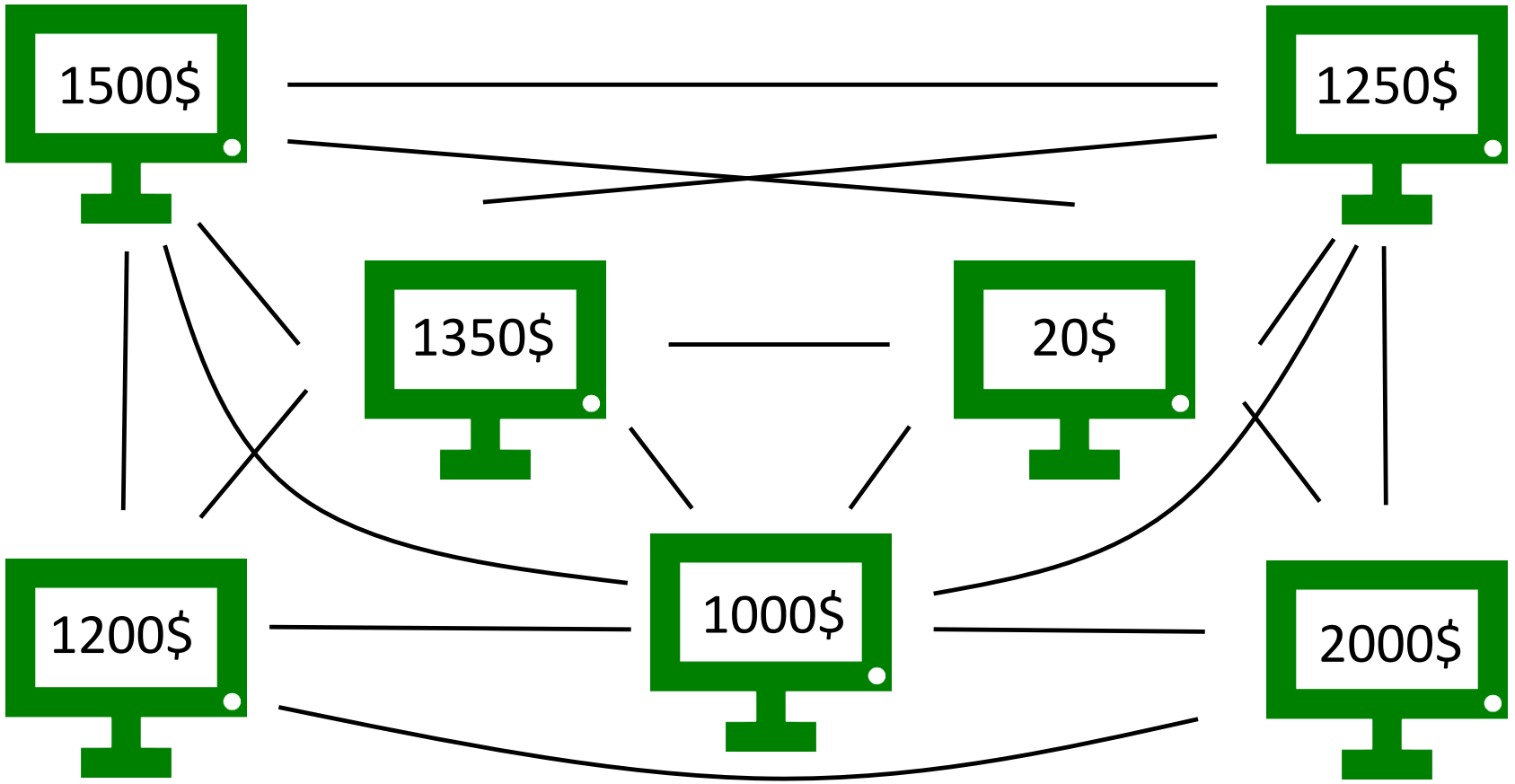
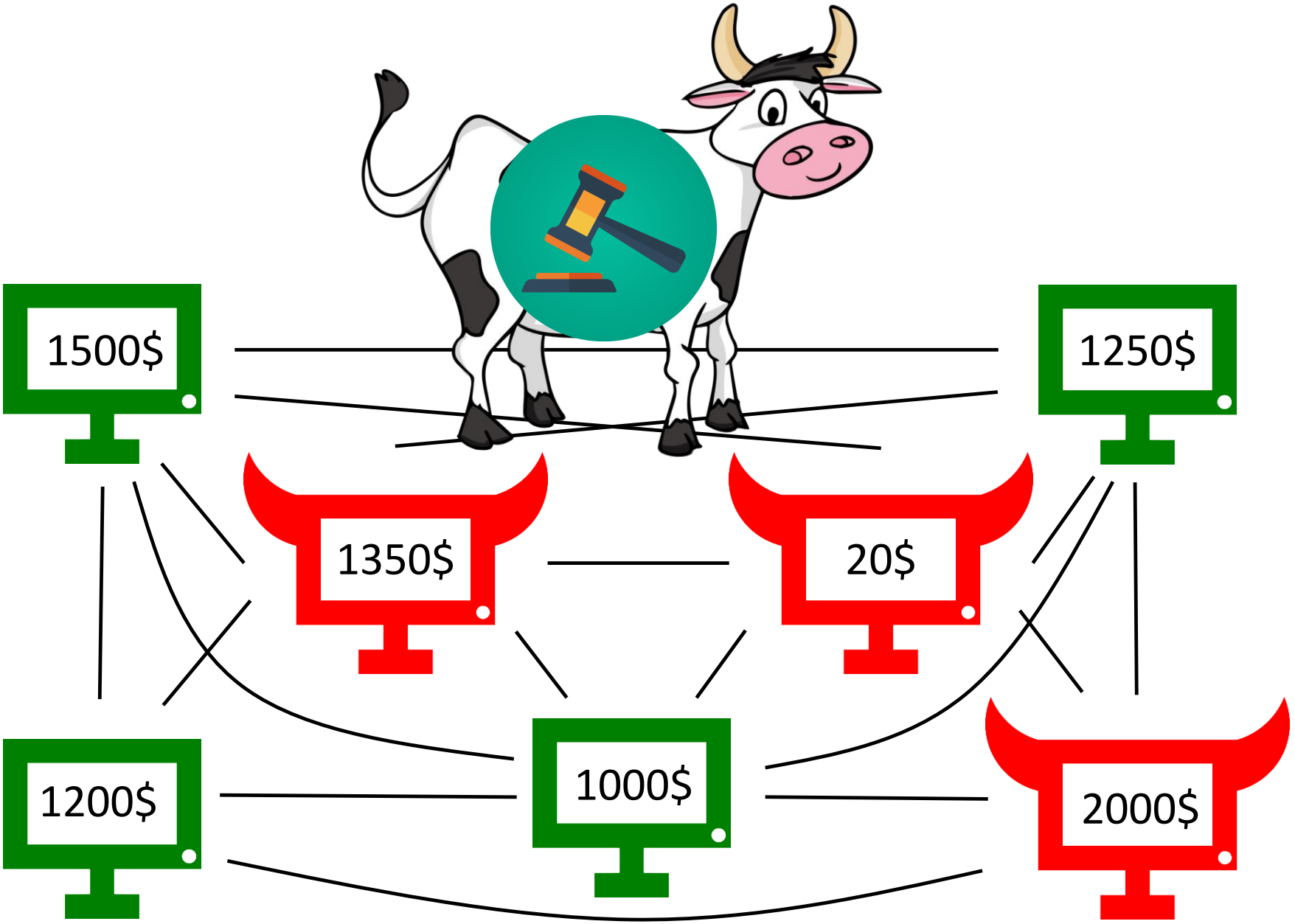
Distributed Auction

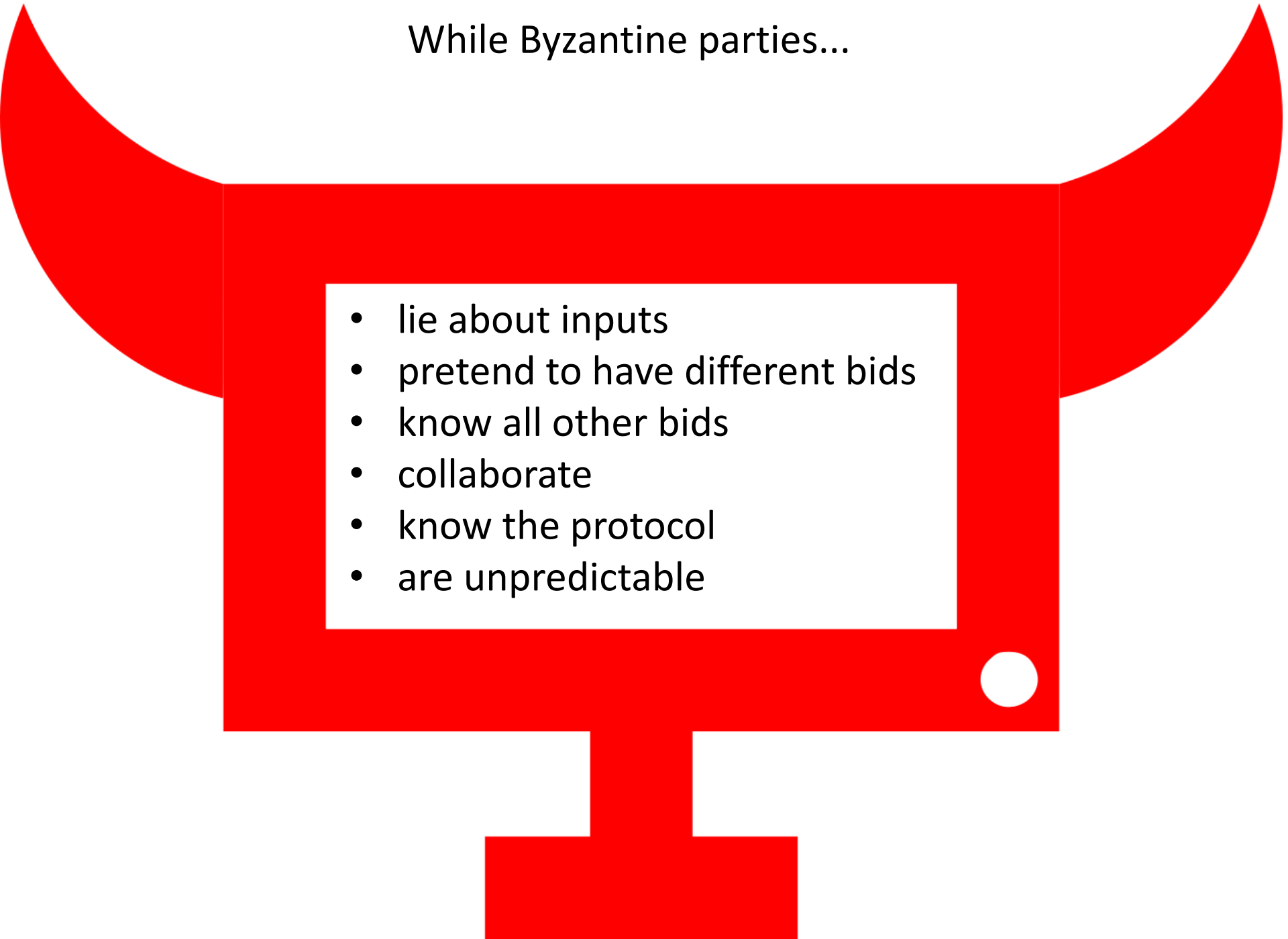
- Fully connected graph
- Synchronous communication



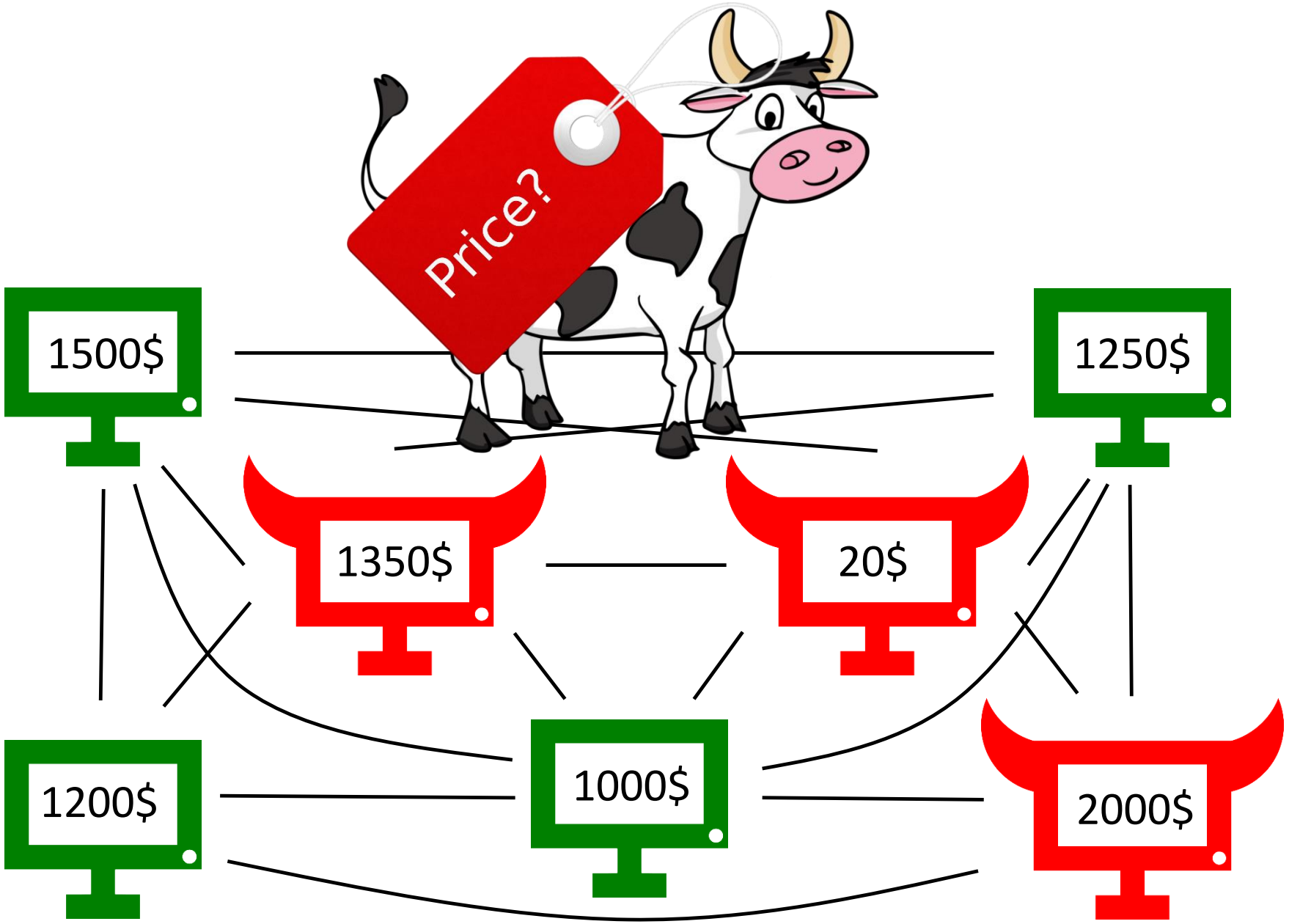
Distributed Auction with Byzantine Parties



While Byzantine parties...

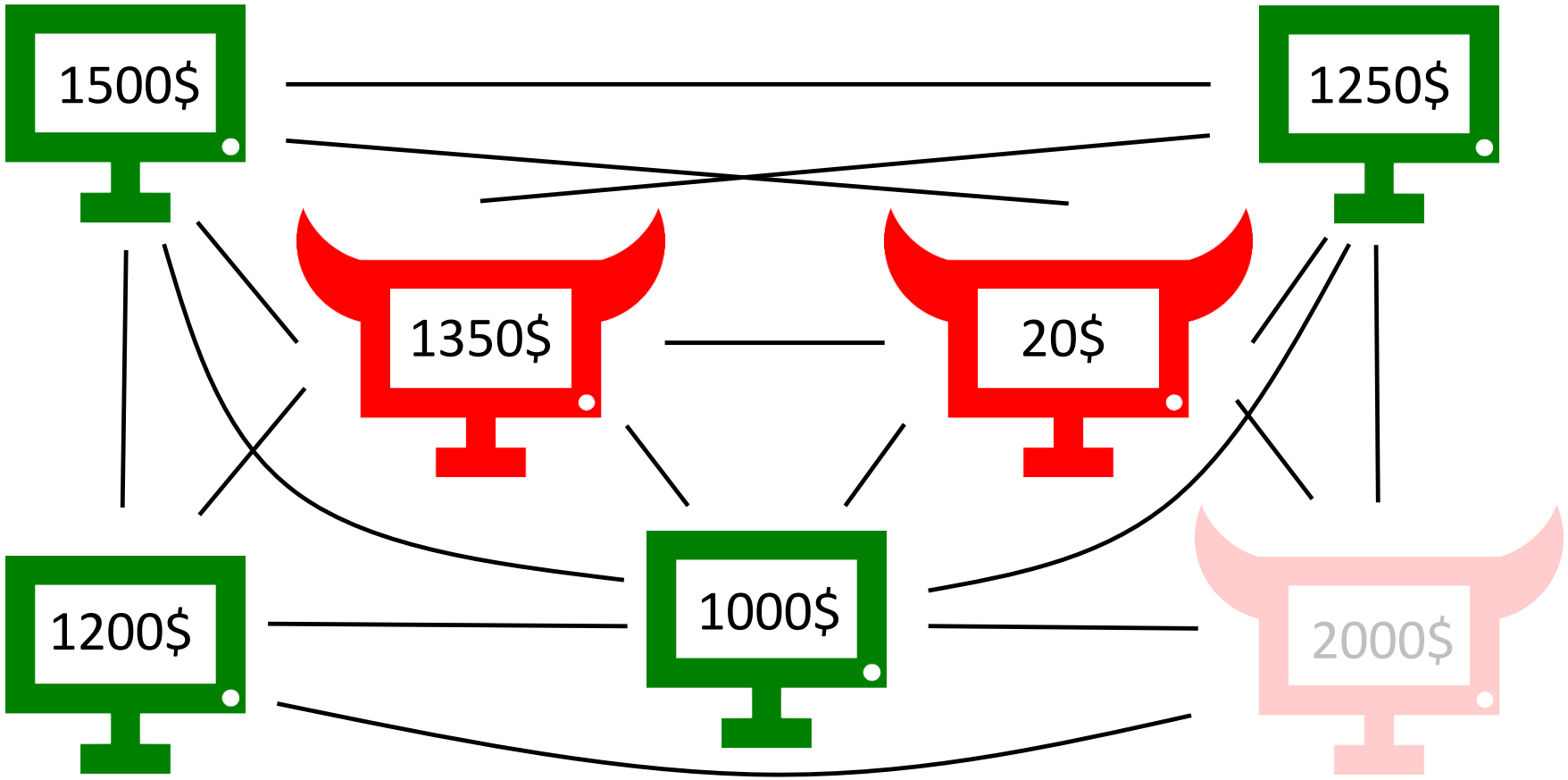


What‘s the fair price?



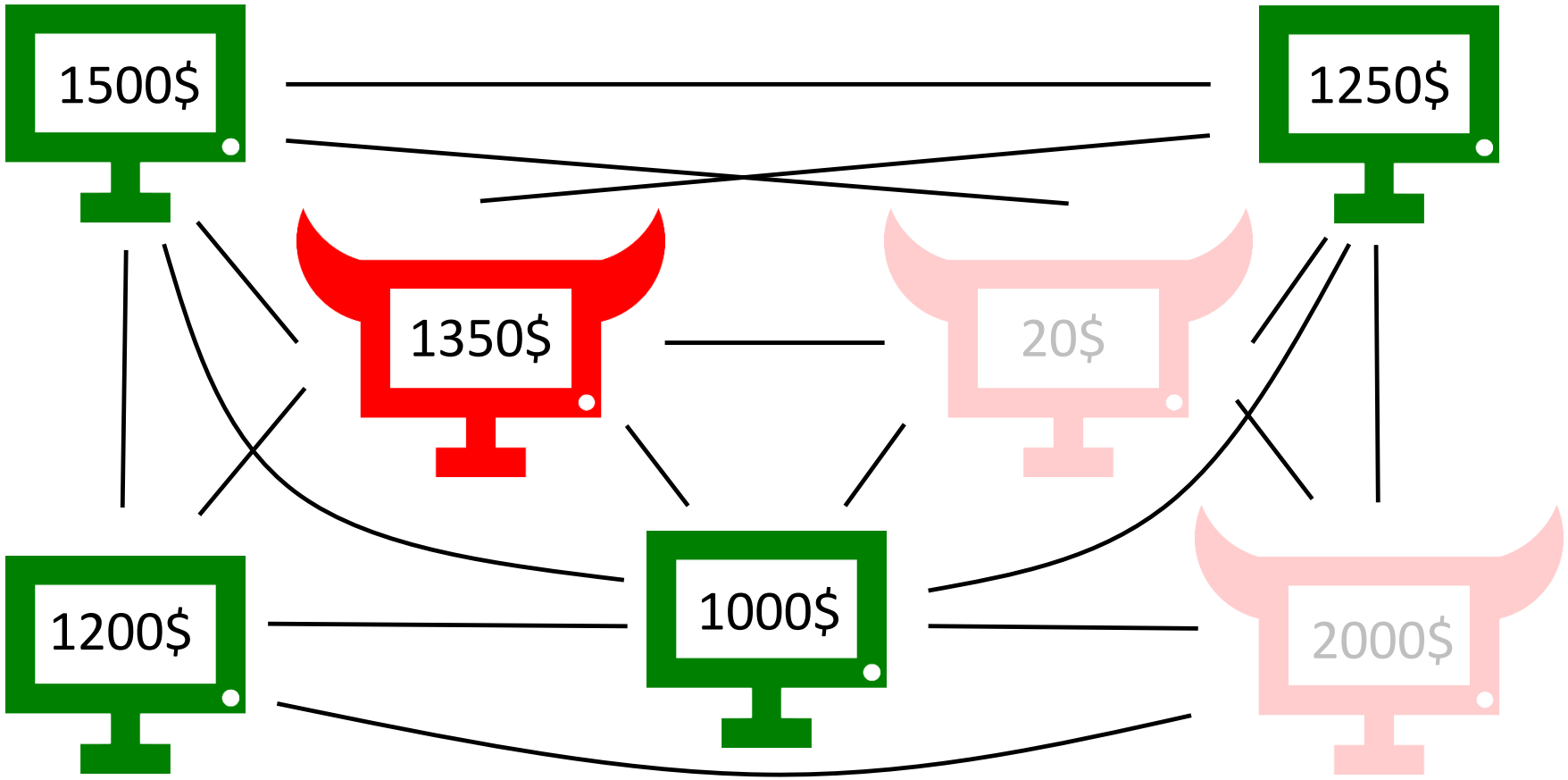
Valdidity Condition

- Remove too high bids

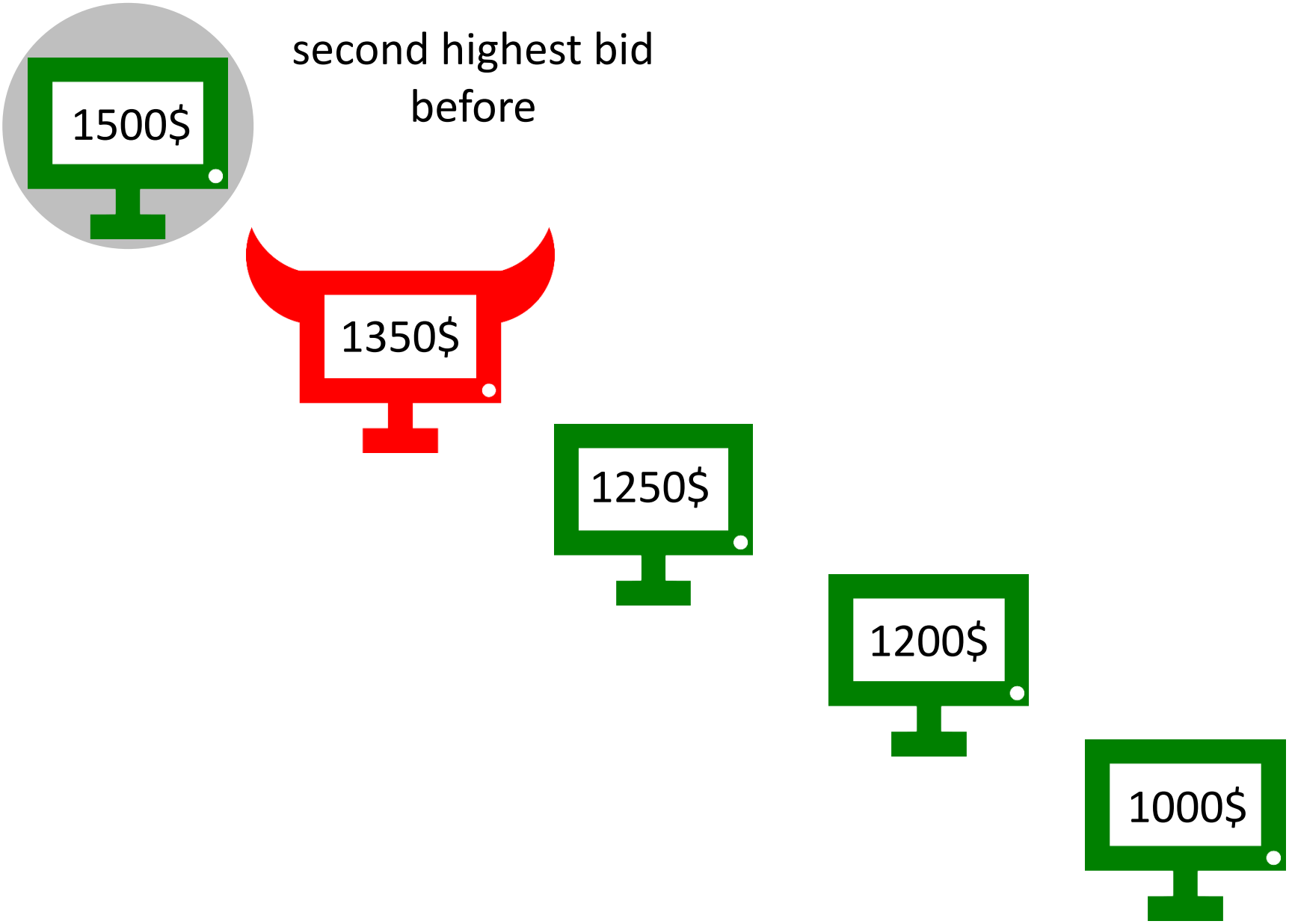


Validity Condition

- Remove too high bids
- Remove loo low bids



Validity Condition



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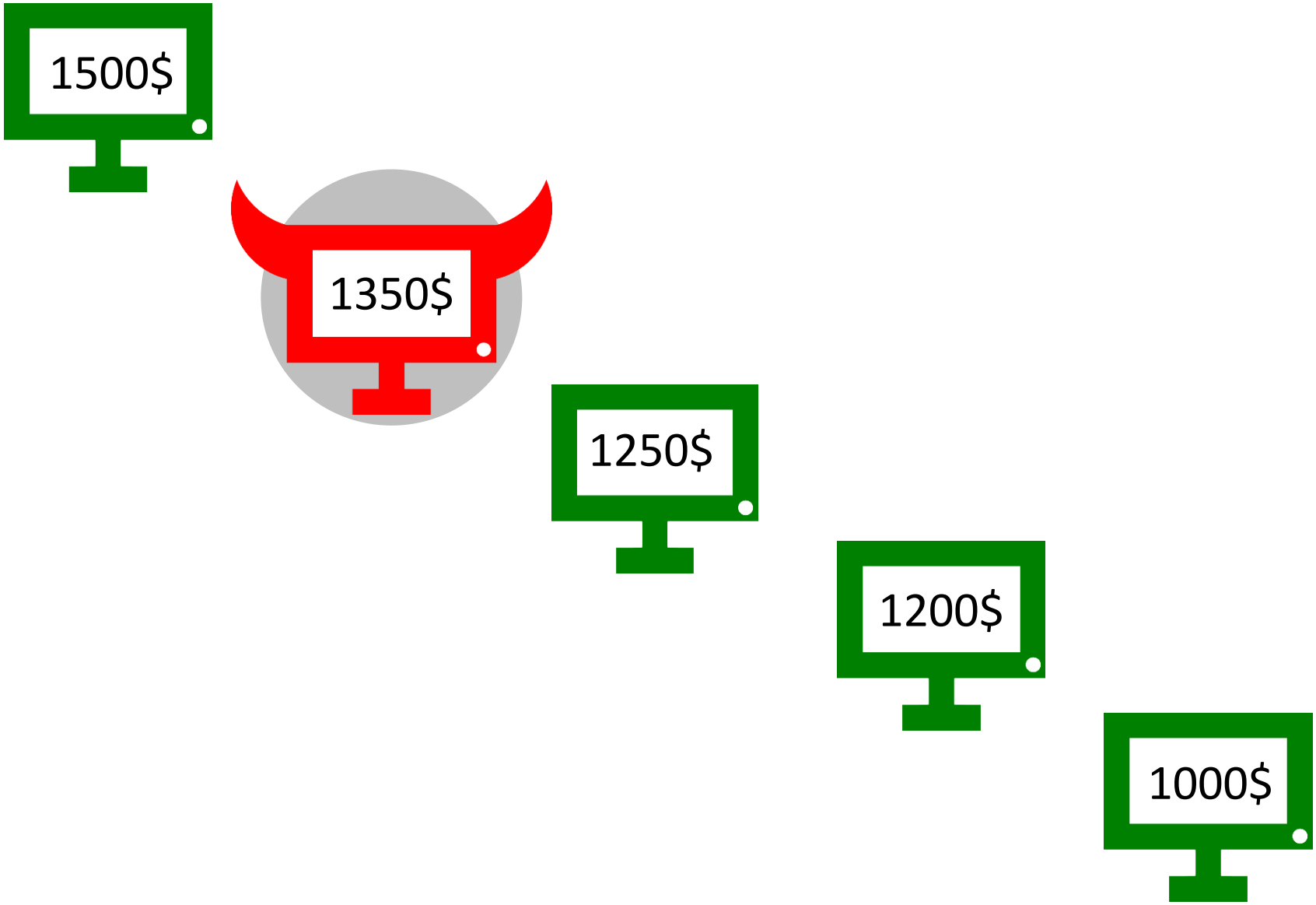
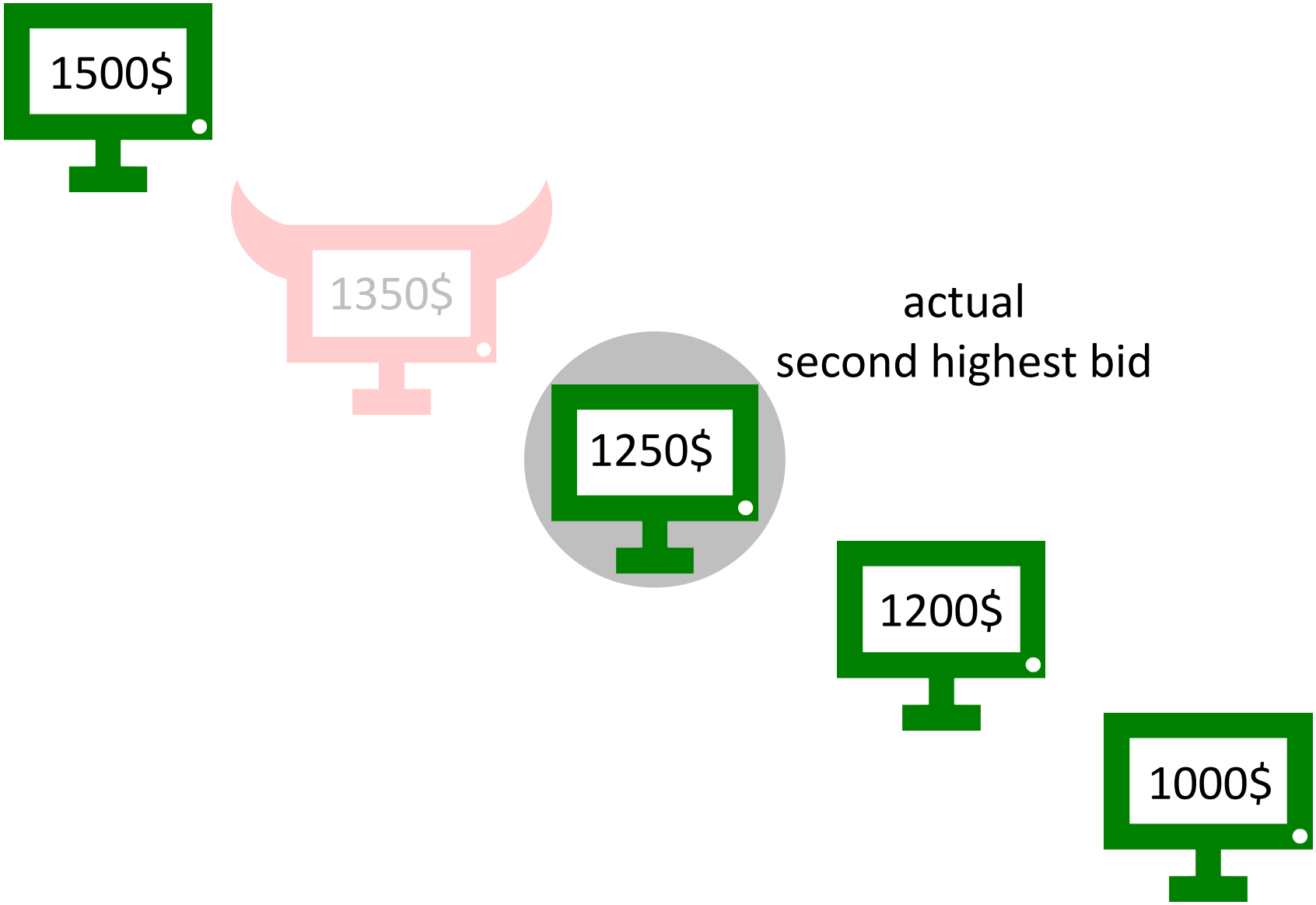
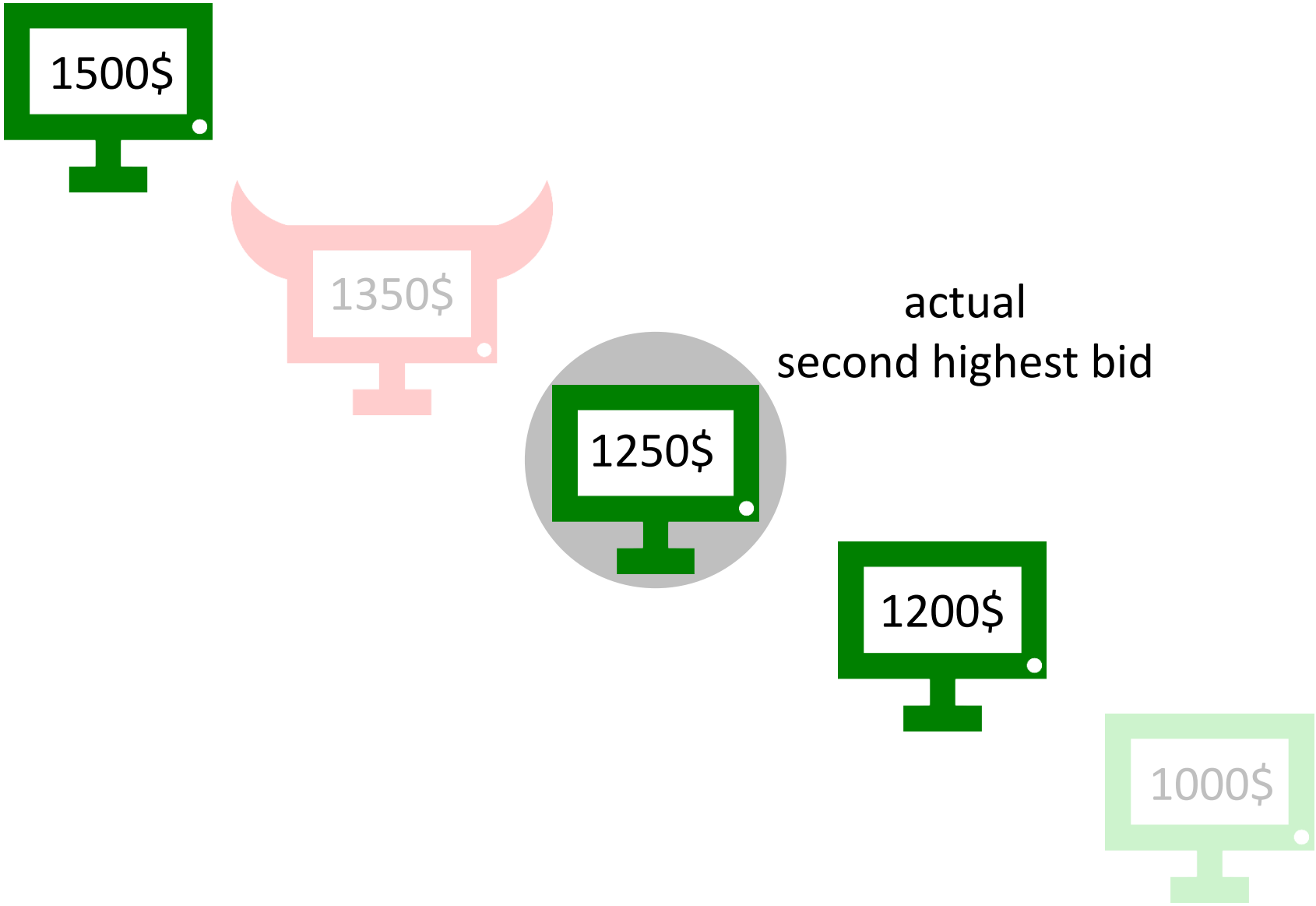


Validity Condition

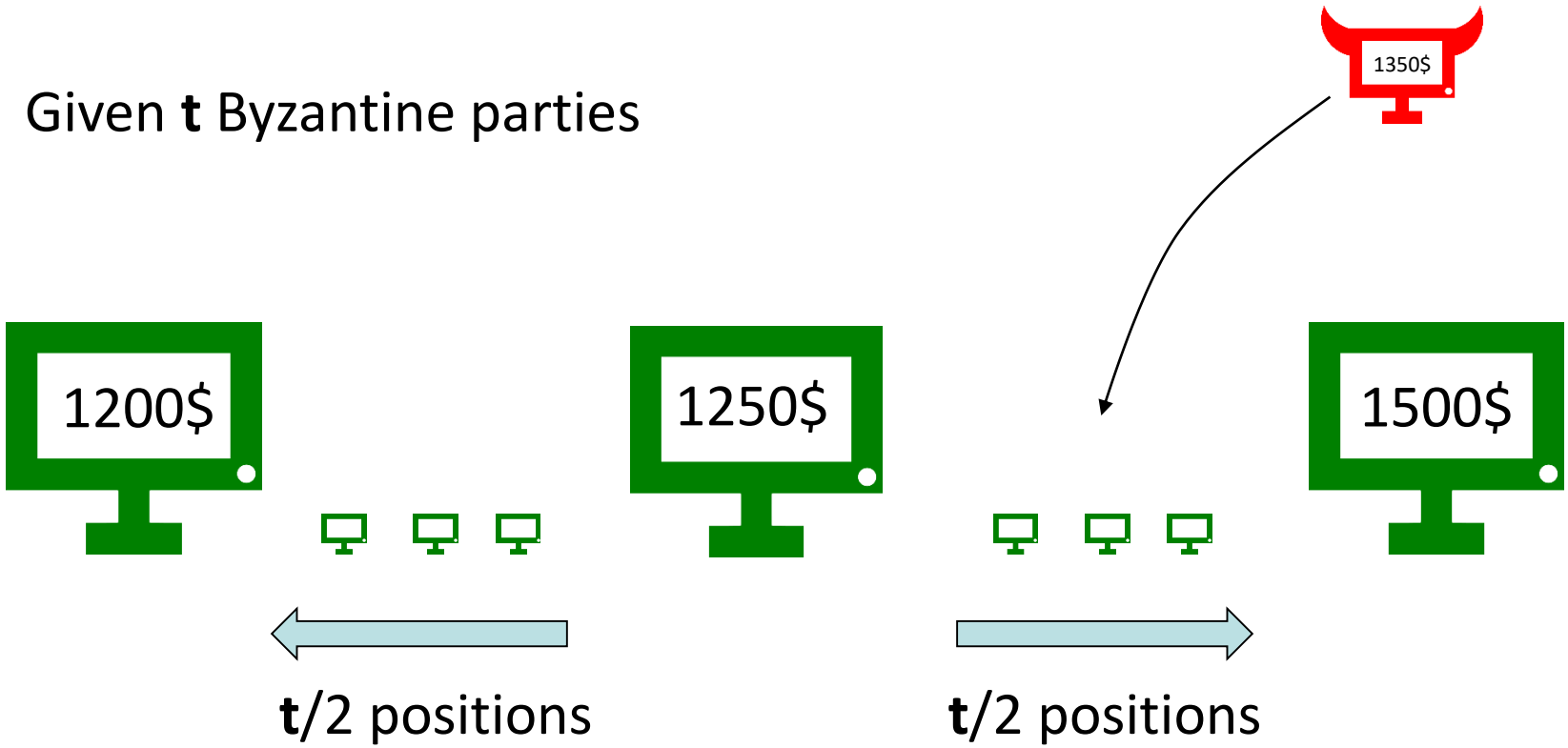


Validity Condition



Interval Validity

Given **t** Byzantine parties



we can accept all bids which are at most t/2 positions away from the wanted bid.

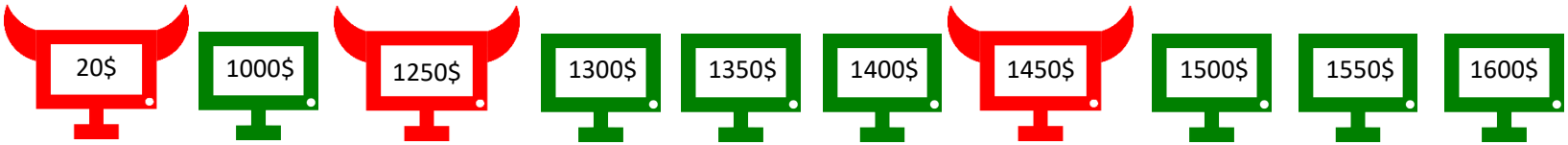
Want …

a synchronous Byzantine agreement algorithm that satsfies

Interval Validity

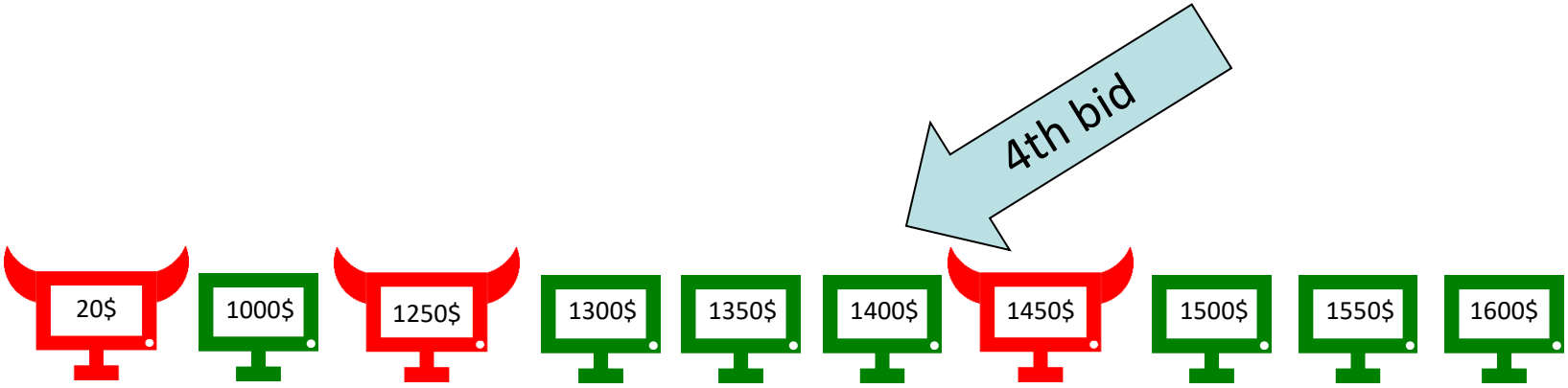
Naive Algorithm

- Byzantine Agreement on each bid
  - Can be done in t+1 rounds exchanging O(n^4) messages



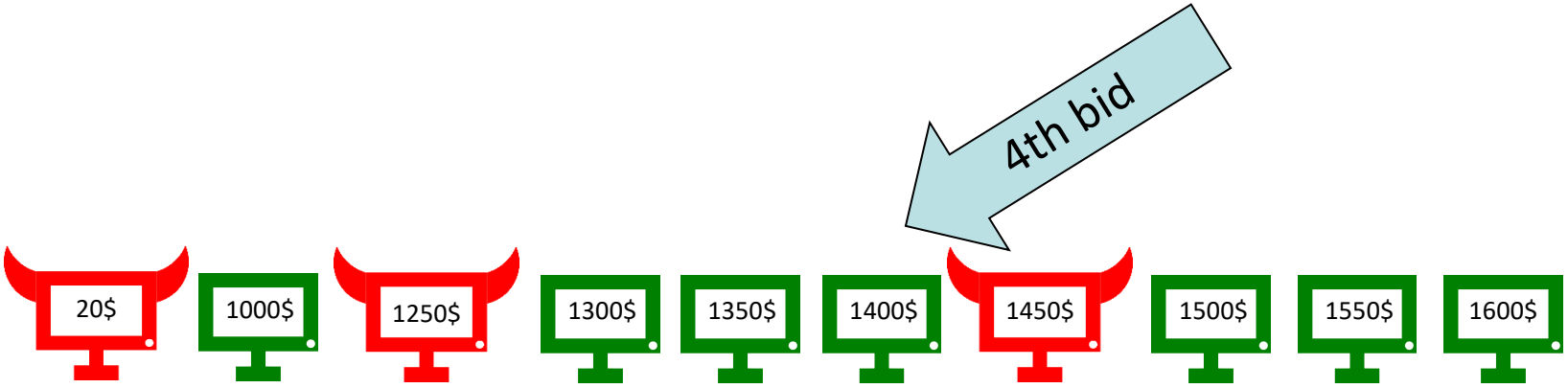
Naive Algorithm

- Choose the k-th smallest value



Naive Algorithm

- Choose the k-th smallest value
  - Choose the **median** between the **k-th** smallest and the **(k+t)** smallest value



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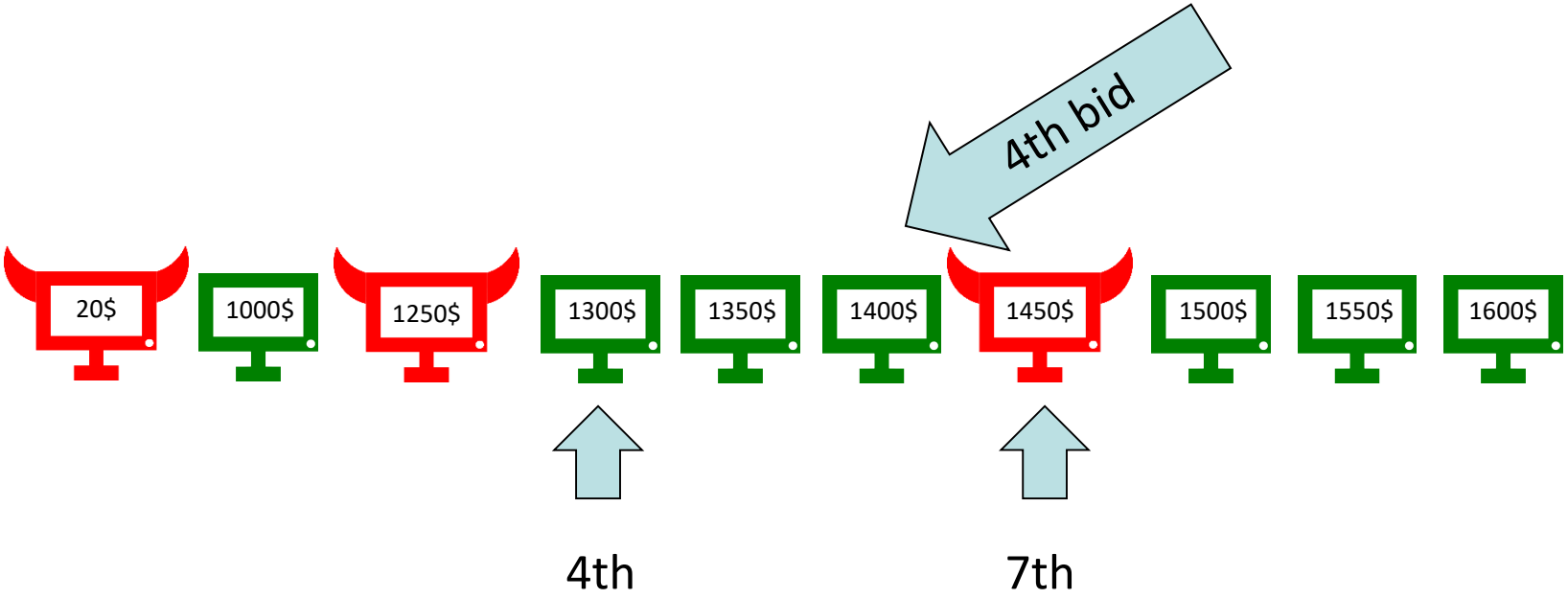

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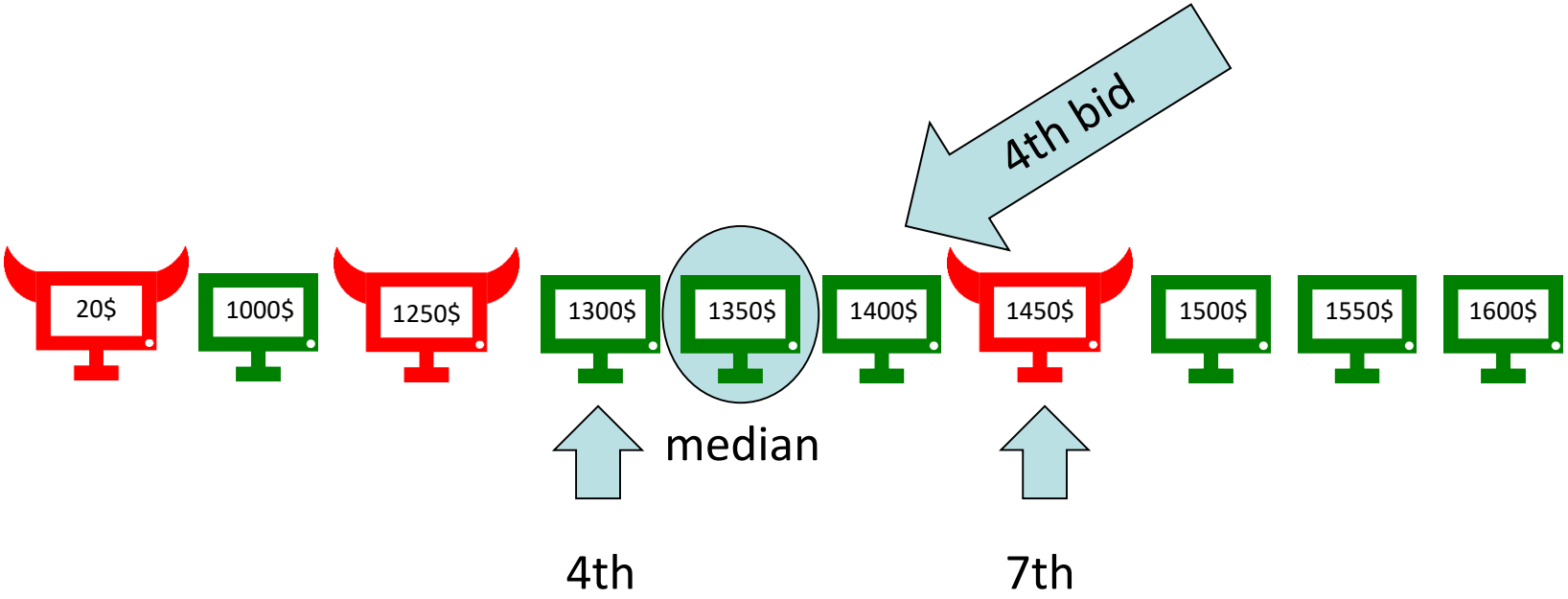

Lower Bound

10 bids, 3 Byzantine, look for the 4th smallest

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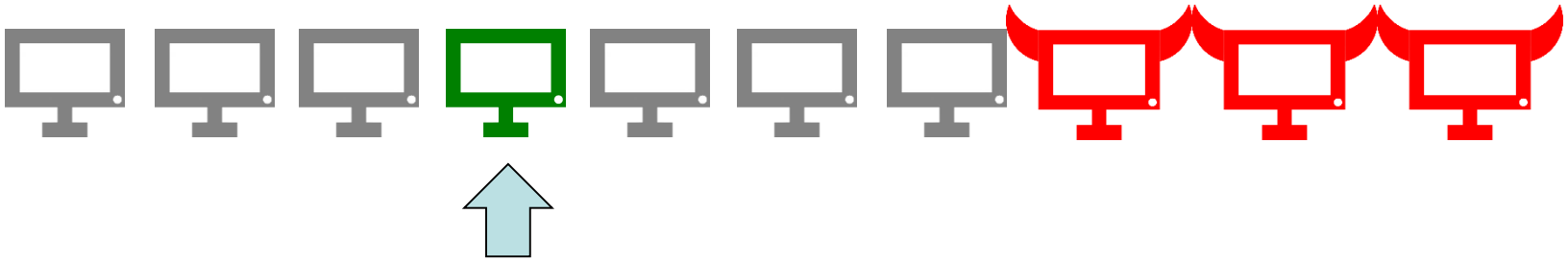

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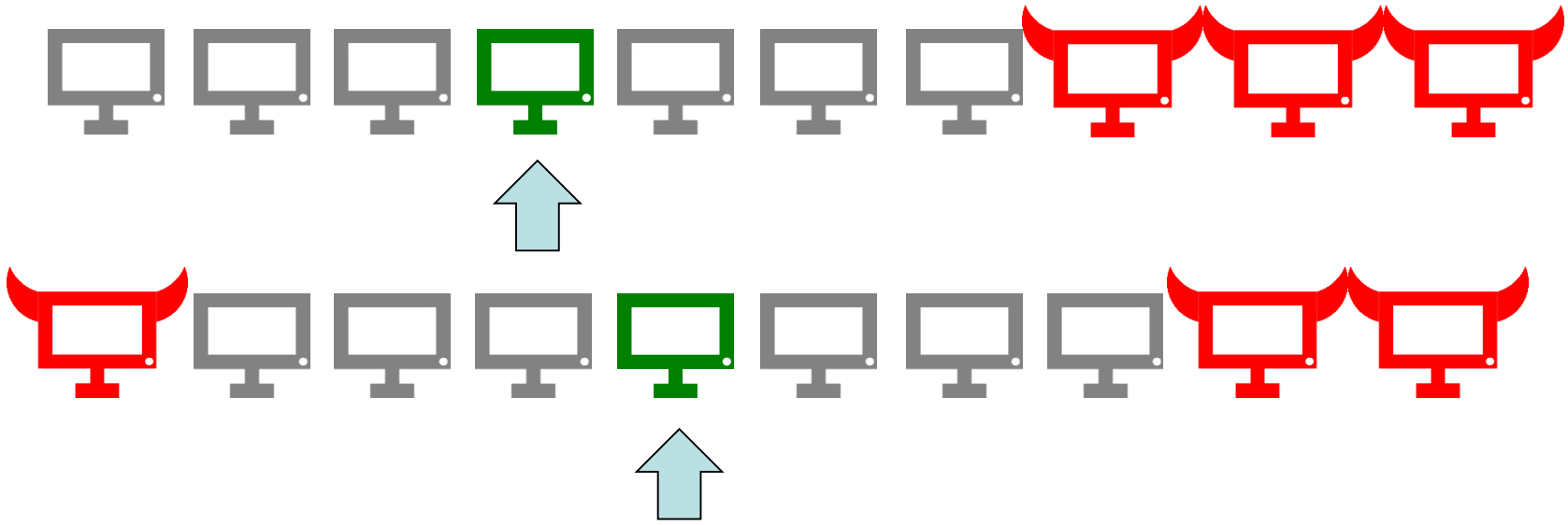

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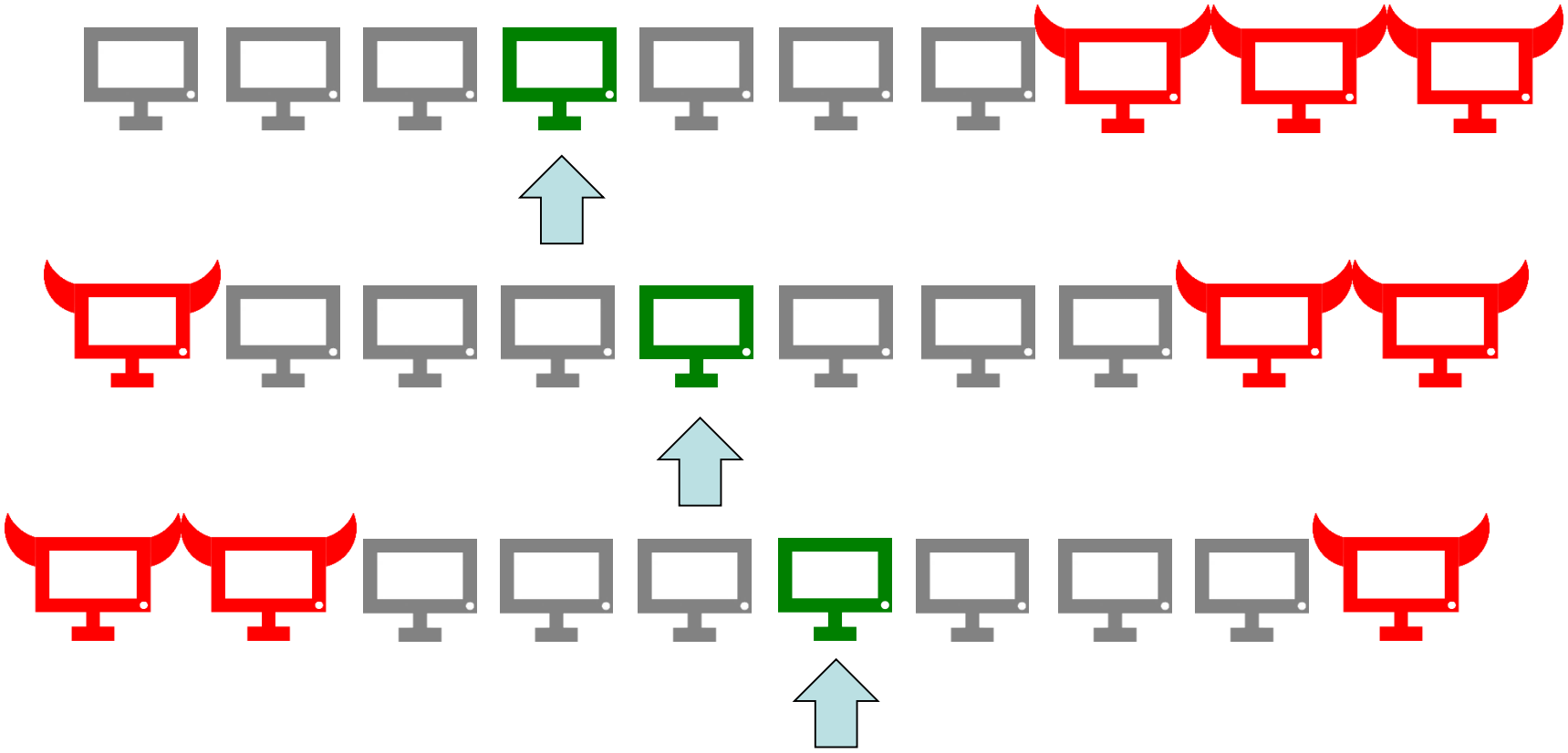

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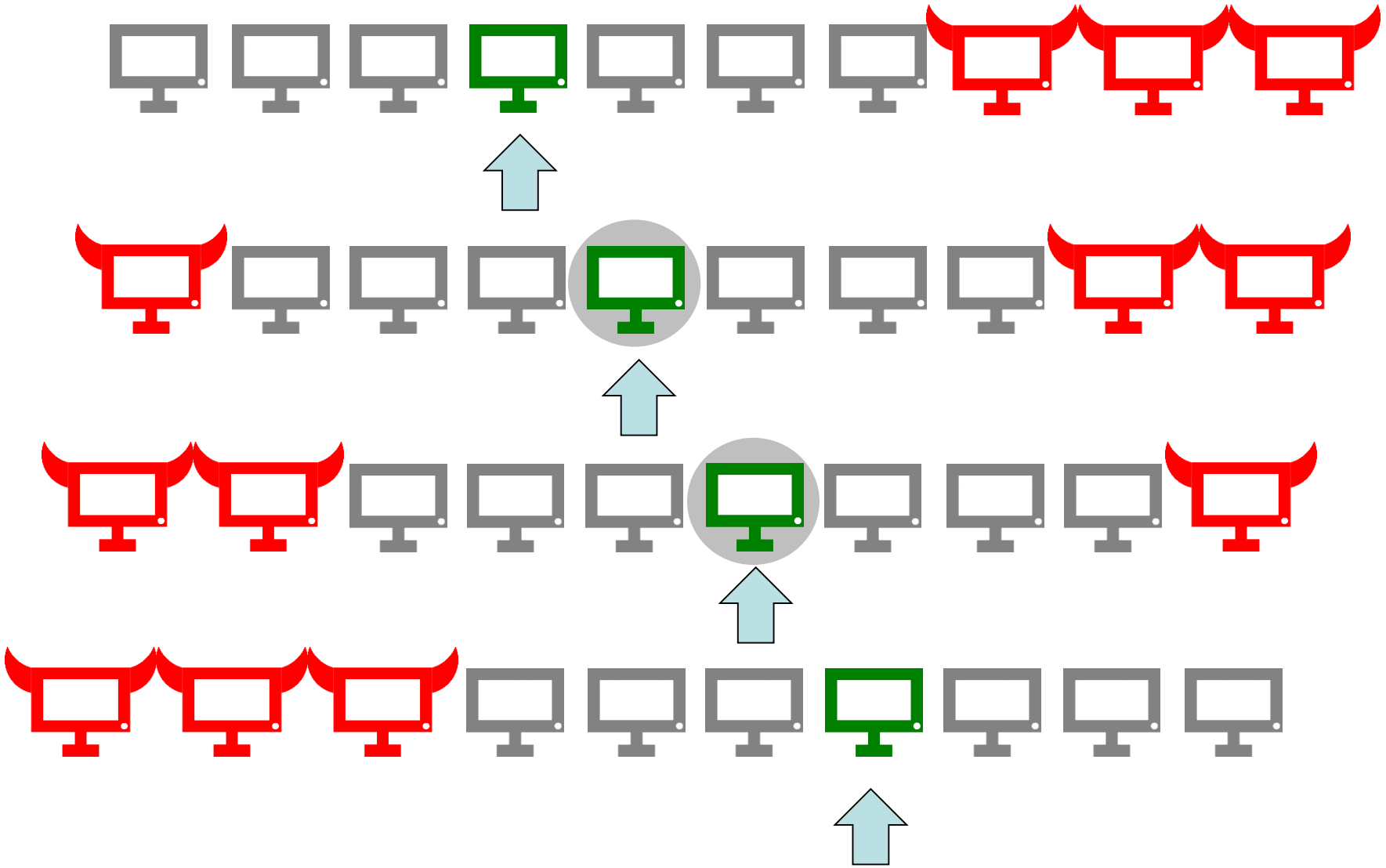

Naive Algorithm

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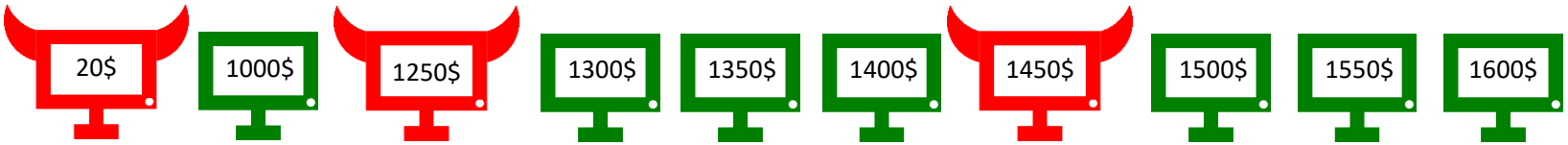
  - Can be done in **t+1** rounds exchanging **O(n^4)** messages



Our Algorithm

- each bidder locally chooses an approximation for the k-th smallest value

- bidders agree on any price inside the interval of all correct bids

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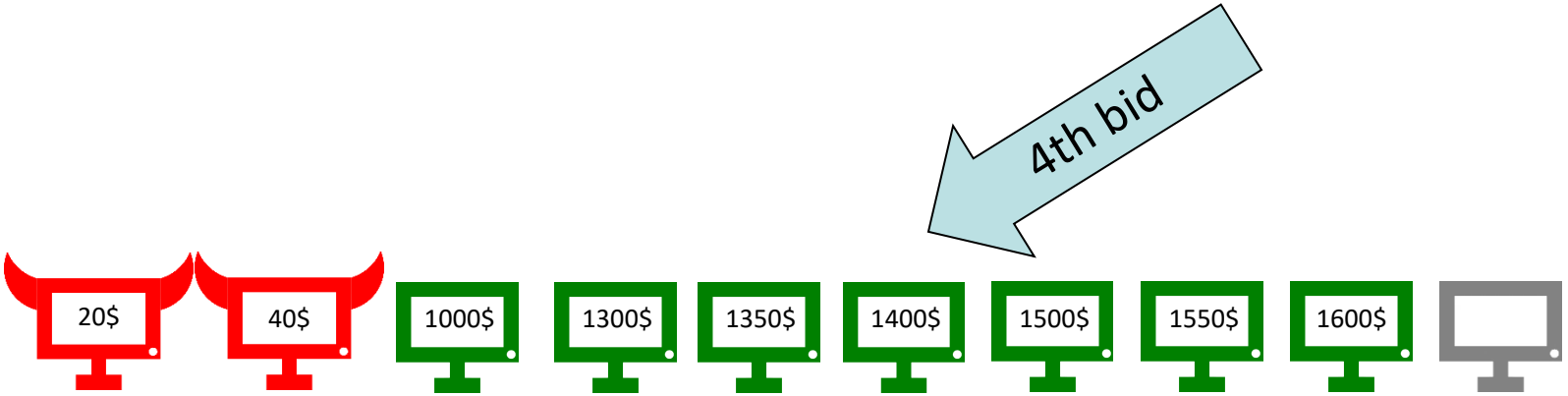

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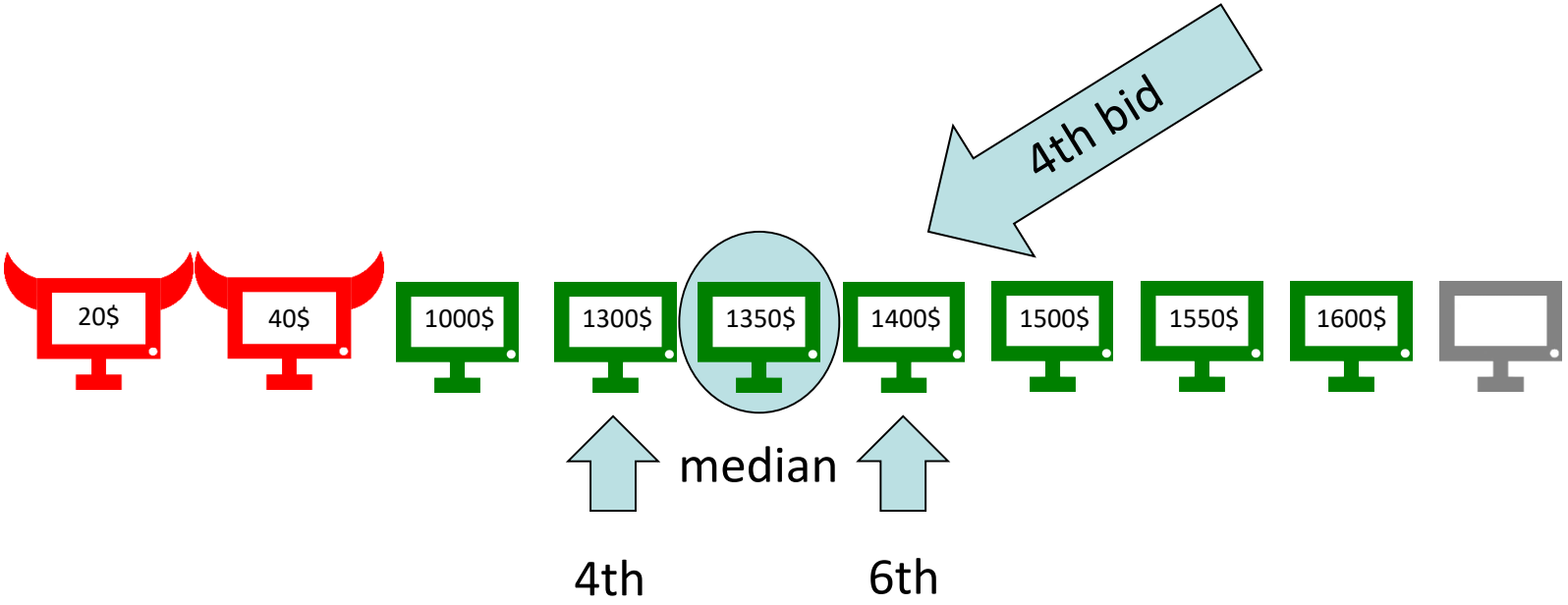

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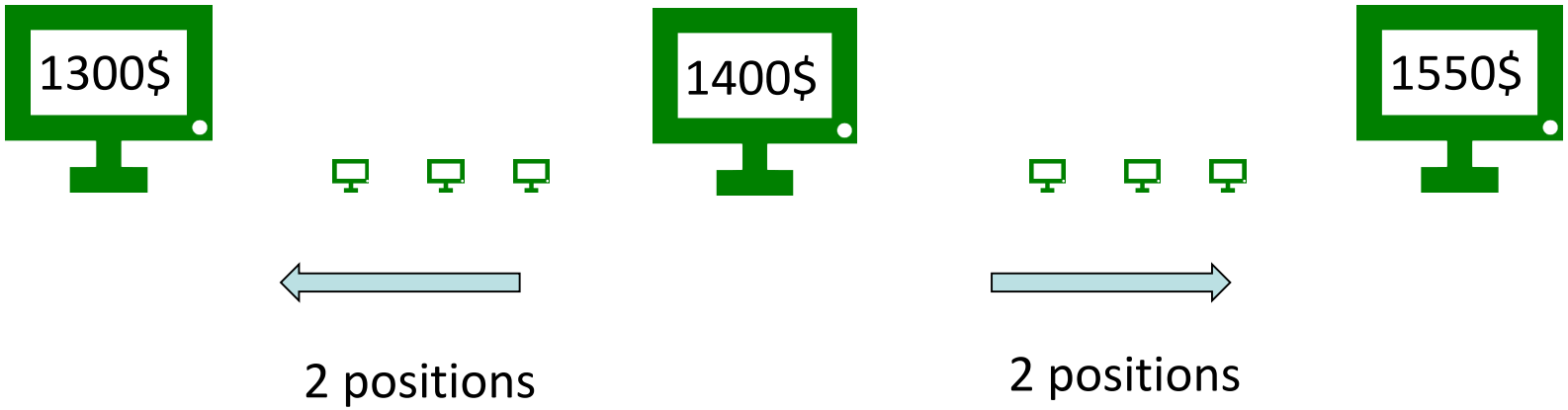
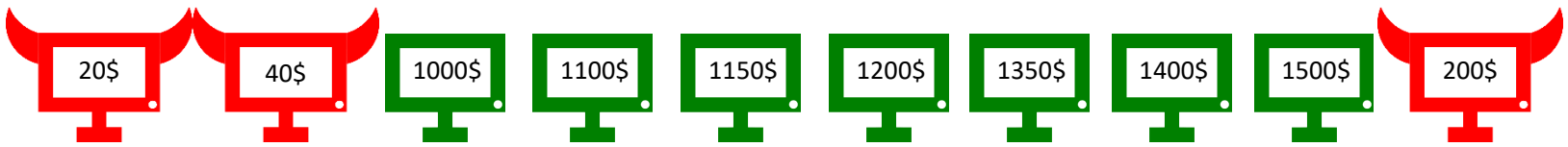


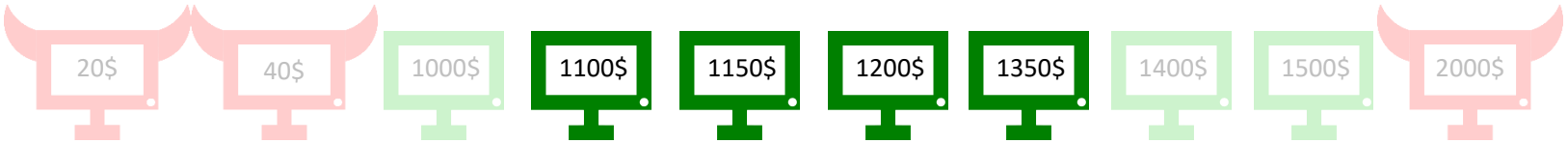
Our Algorithm

- bidders agree on any price inside the interval of all correct bids
  - receive approximations from every node



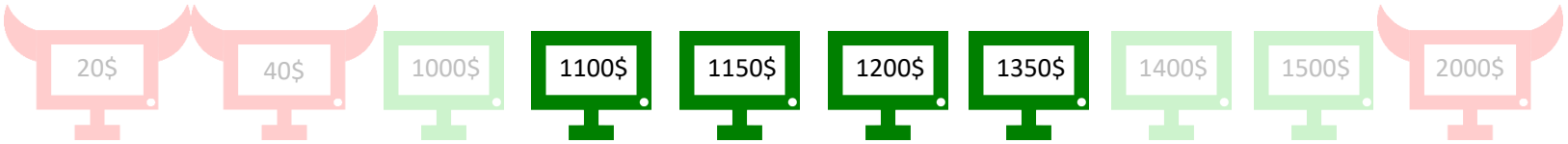
Our Algorithm

- bidders agree on any price inside the interval of all correct bids
  - receive approximations from every node
  - remove **too low** and **too high** bids



Our Algorithm

- bidders agree on any price inside the interval of all correct bids
  - receive approximations from every node
  - remove **too low** and **too high** bids
  - apply **King algorithm** for agreement



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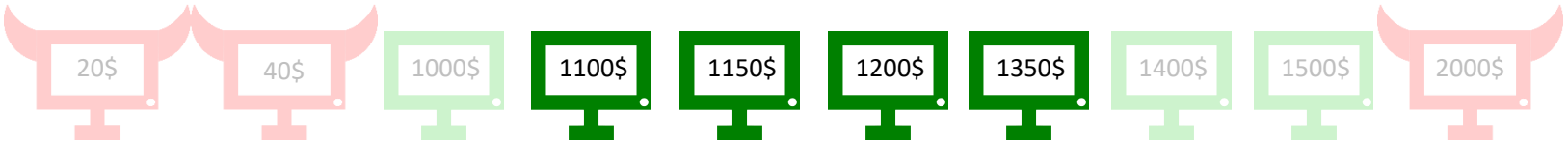
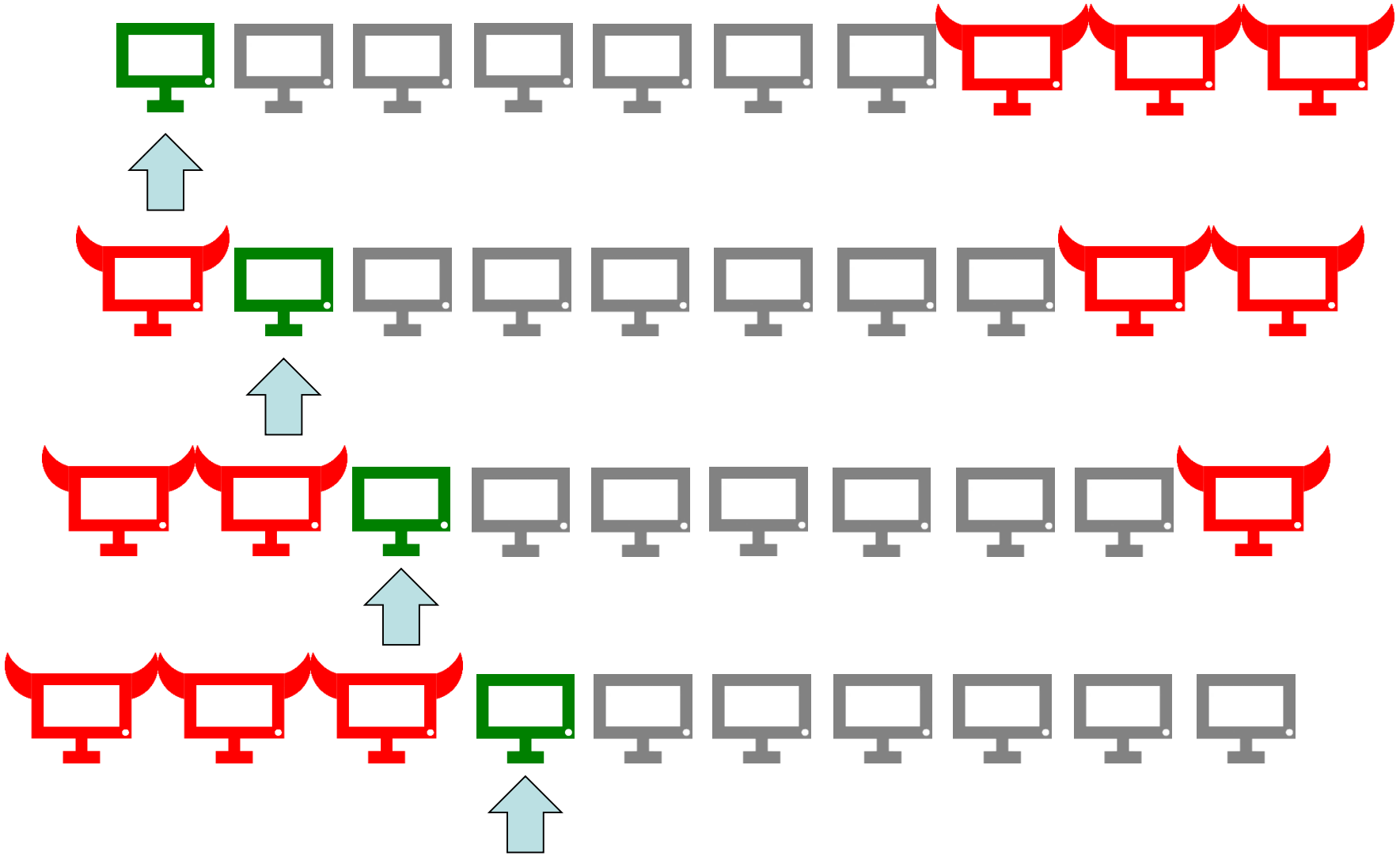


t+1 rounds and O(n^3) messages

Special Cases - Minimum

10 bids, 3 Byzantine, look for minimum



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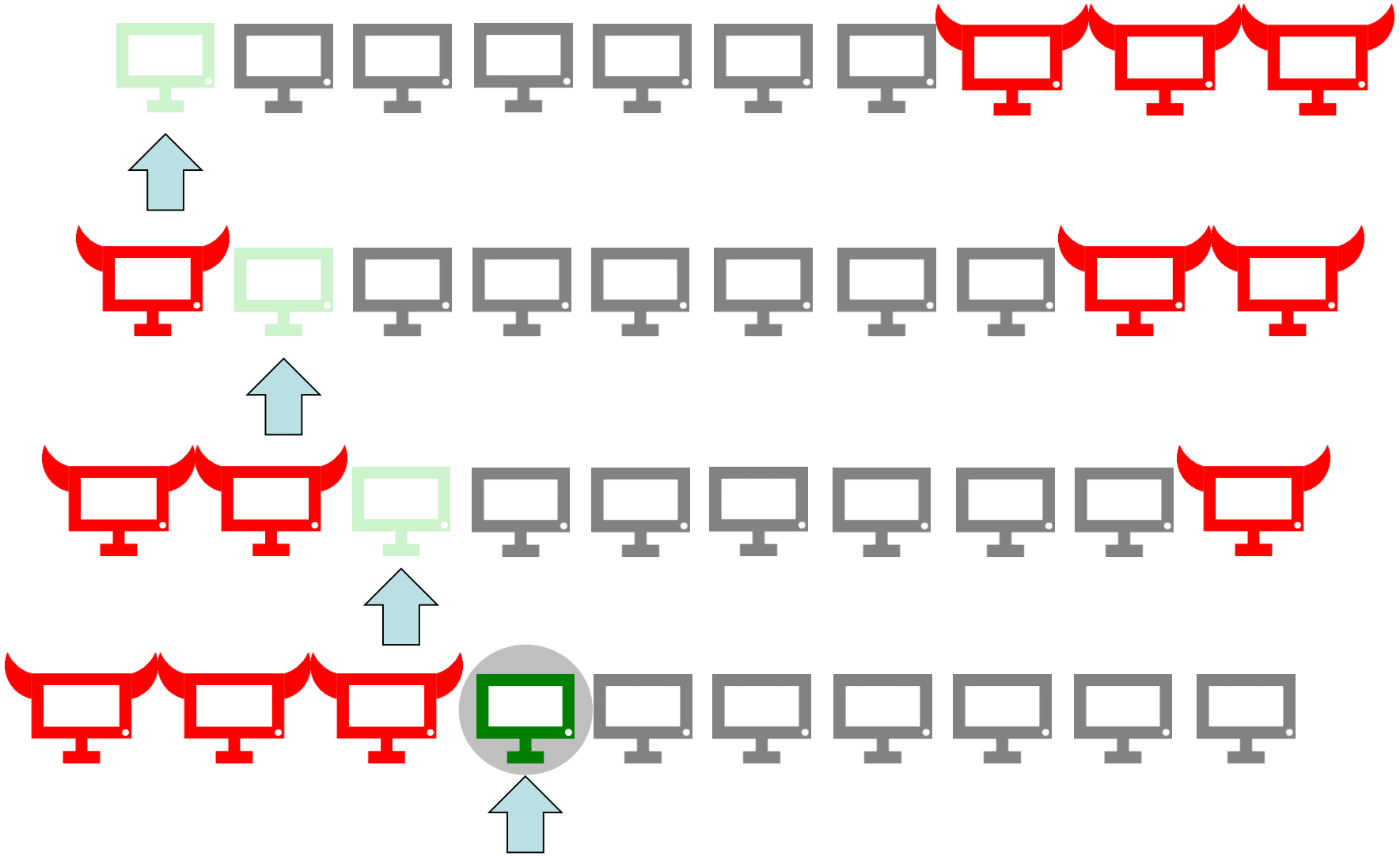
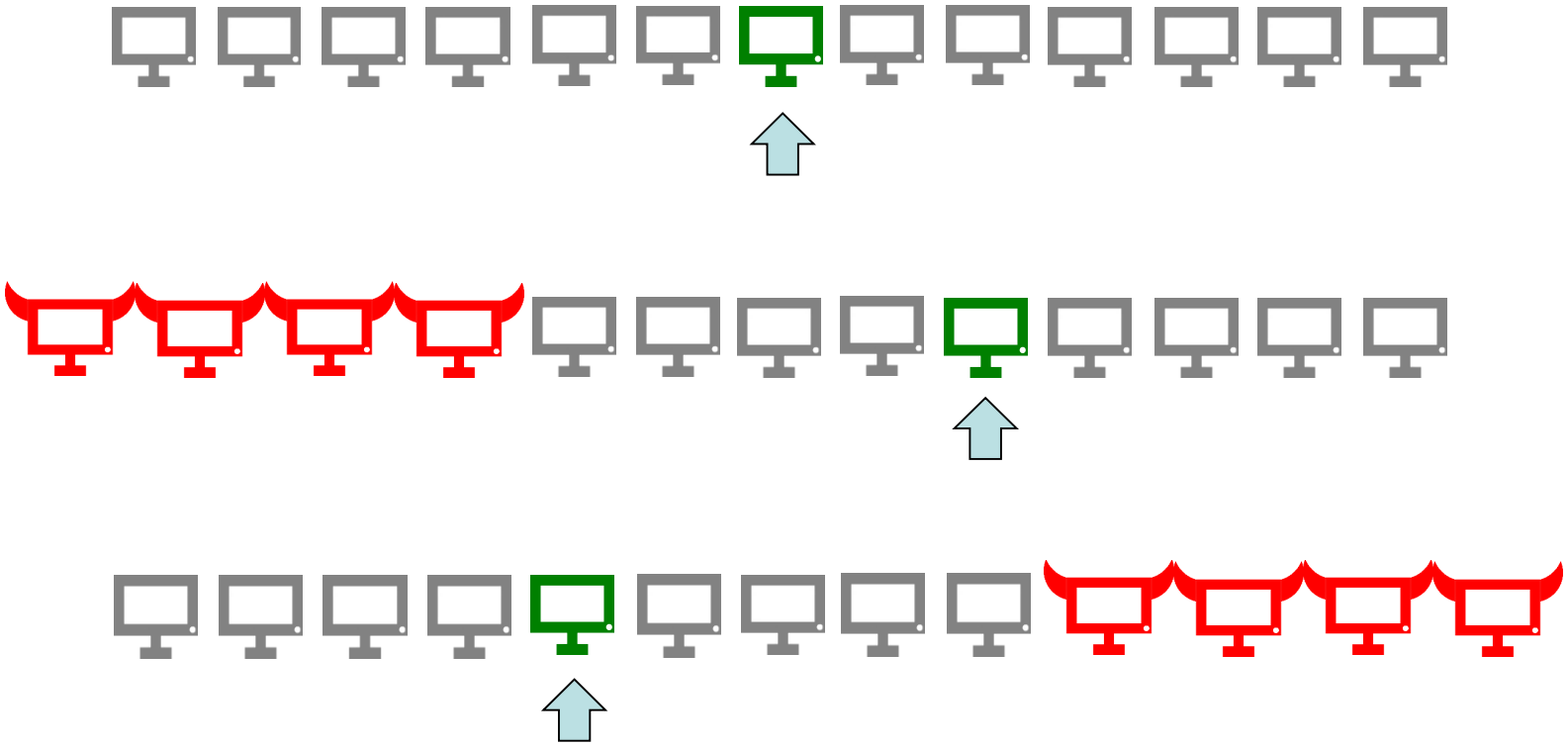


Special Cases – Median

13 bids, 4 Byzantine, look for the median



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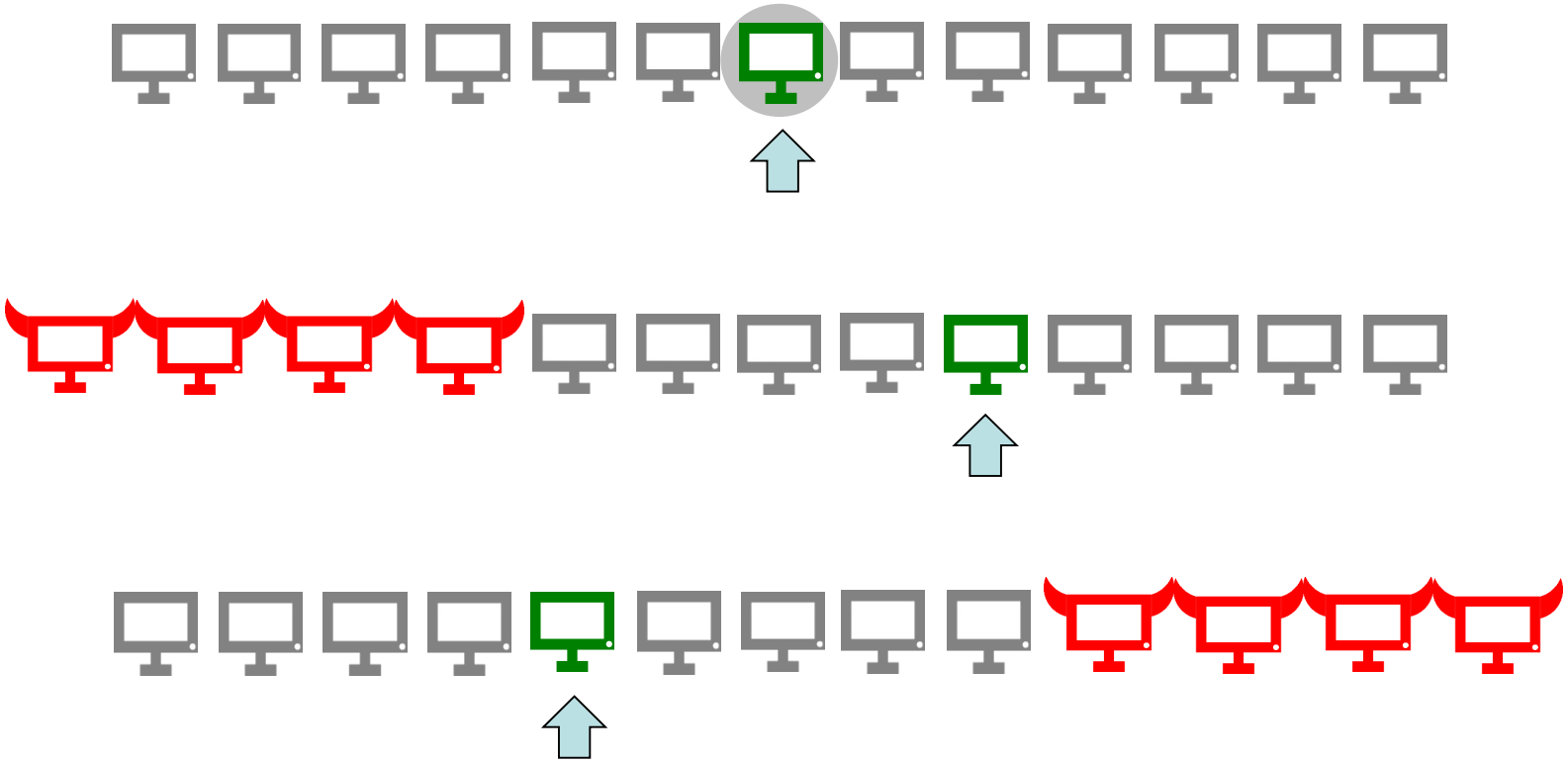

What did we achive?

Cow at an auction...	any real-valued agreement
Fair price...	any reasonable agreement value (also min, max, or median)
Bid close to the 4th smallest bid...	Interval Validity


Questions?