Exploiting a Prioritized MAC Protocol to Efficiently Compute Min and Max in Multihop Networks

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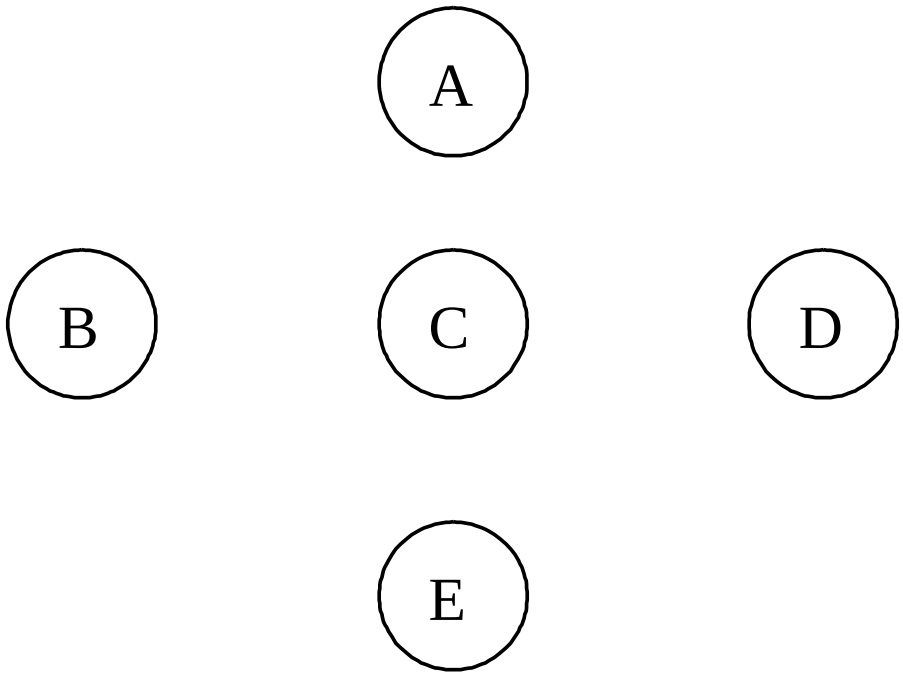
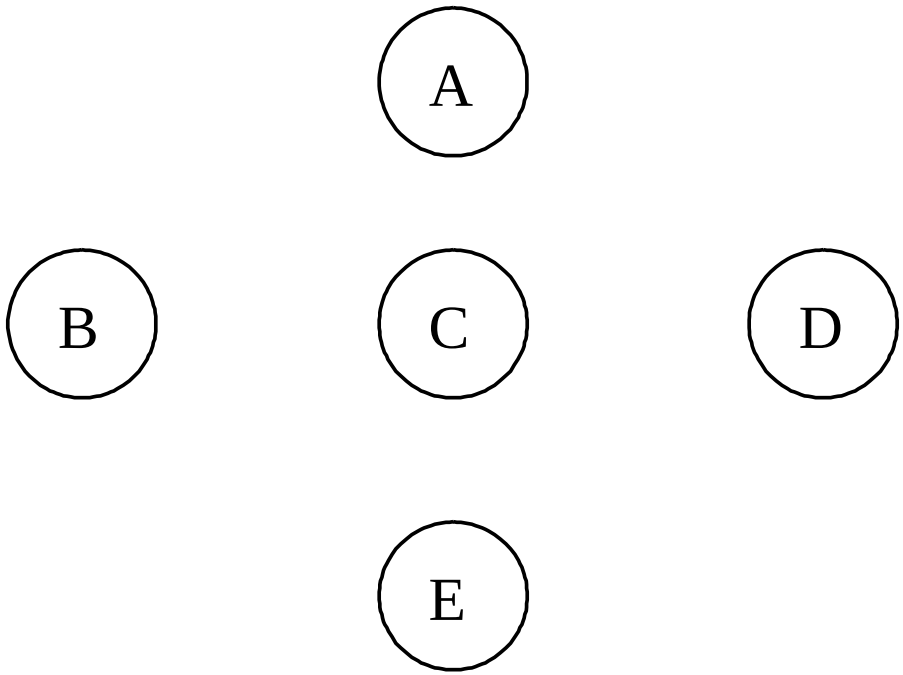
Institute Polytechnic Porto
Portugal



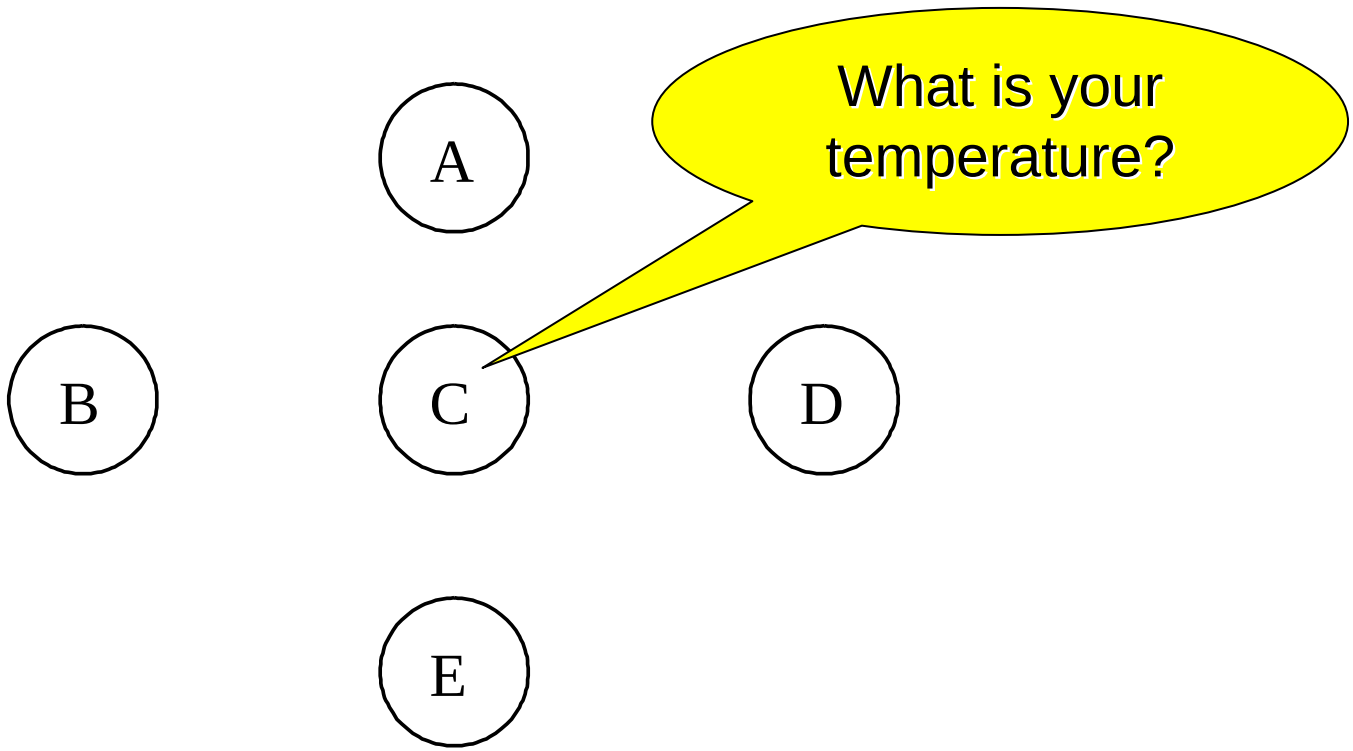
A wireless network with 5 computer nodes.

Calculating the maximum temperature



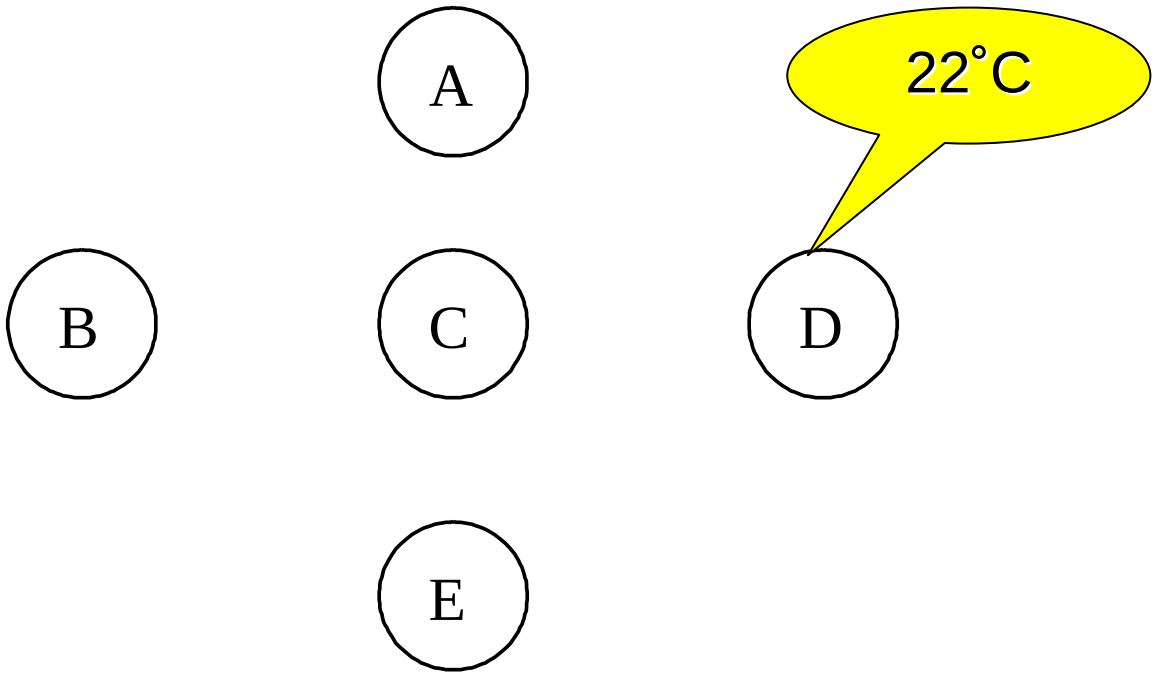
One node (node C) wants to know the maximum temperature in an area.

Calculating the maximum temperature



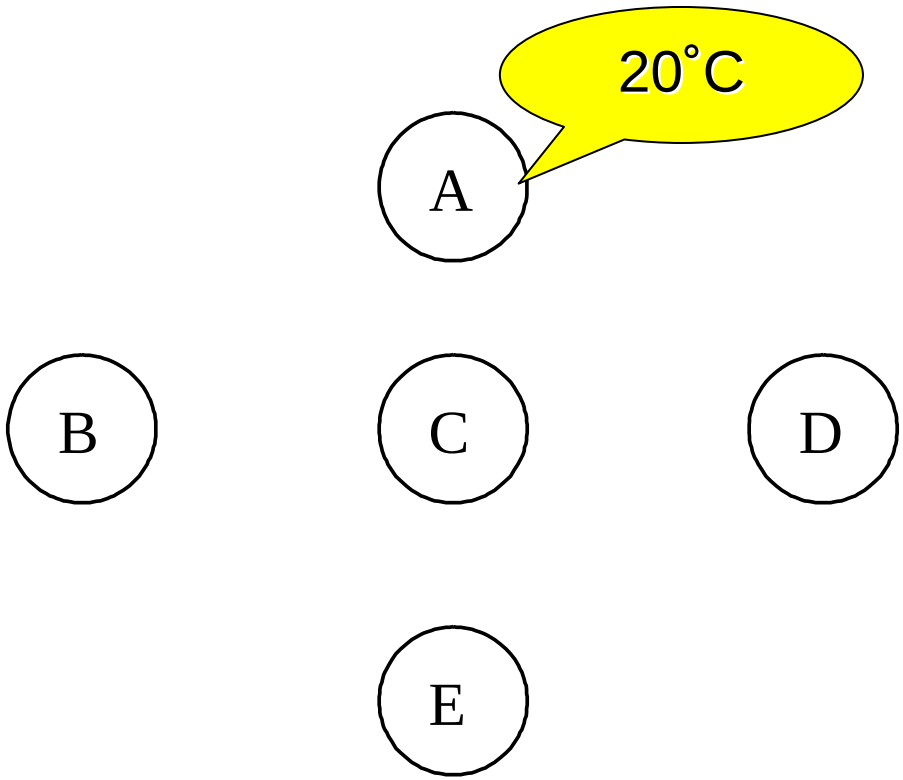
Node C broadcasts a request.

Calculating the maximum temperature



The other nodes respond.

Calculating the maximum temperature



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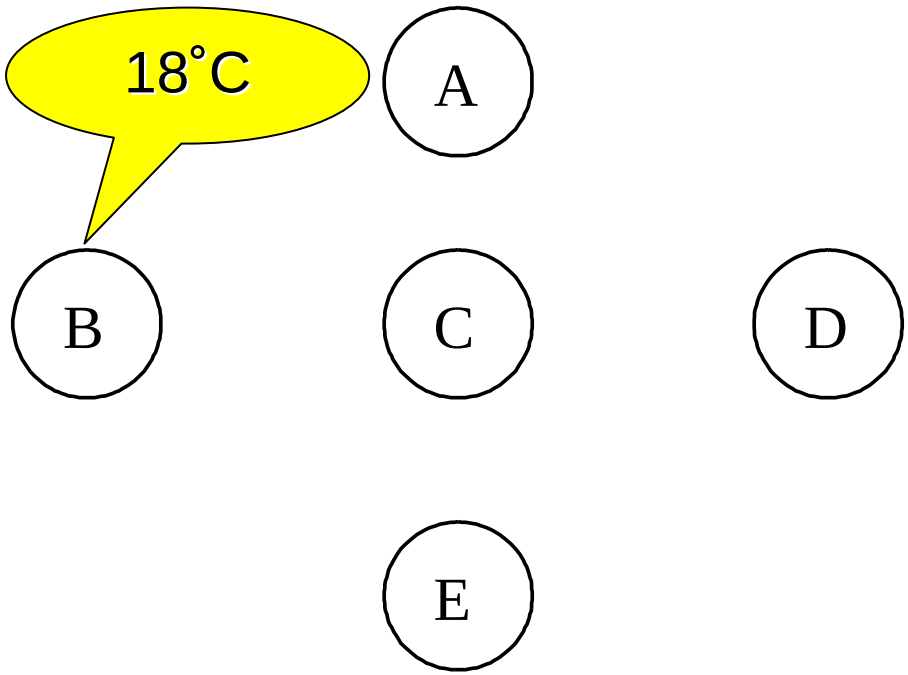

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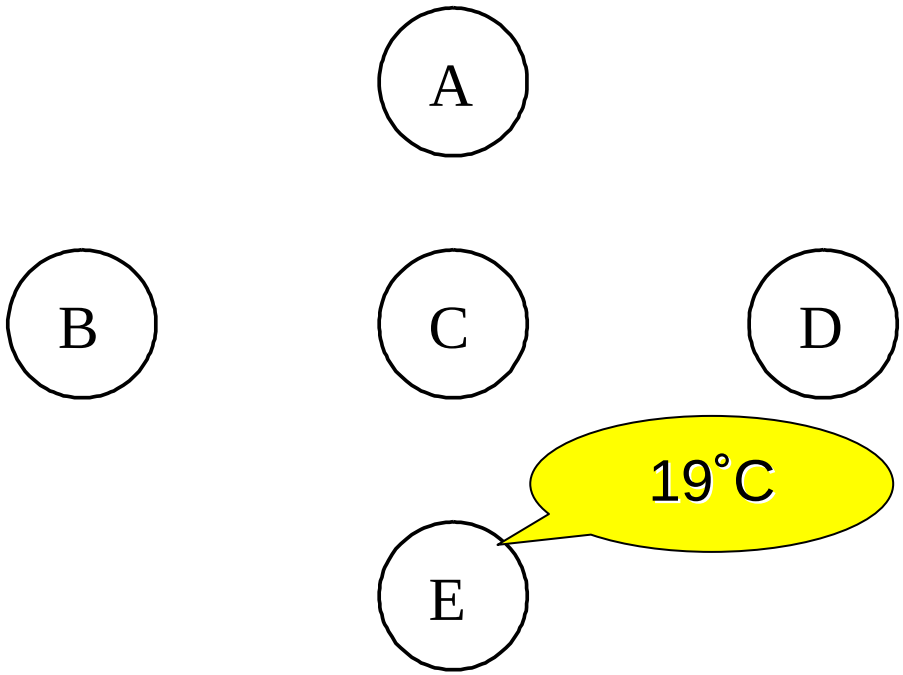

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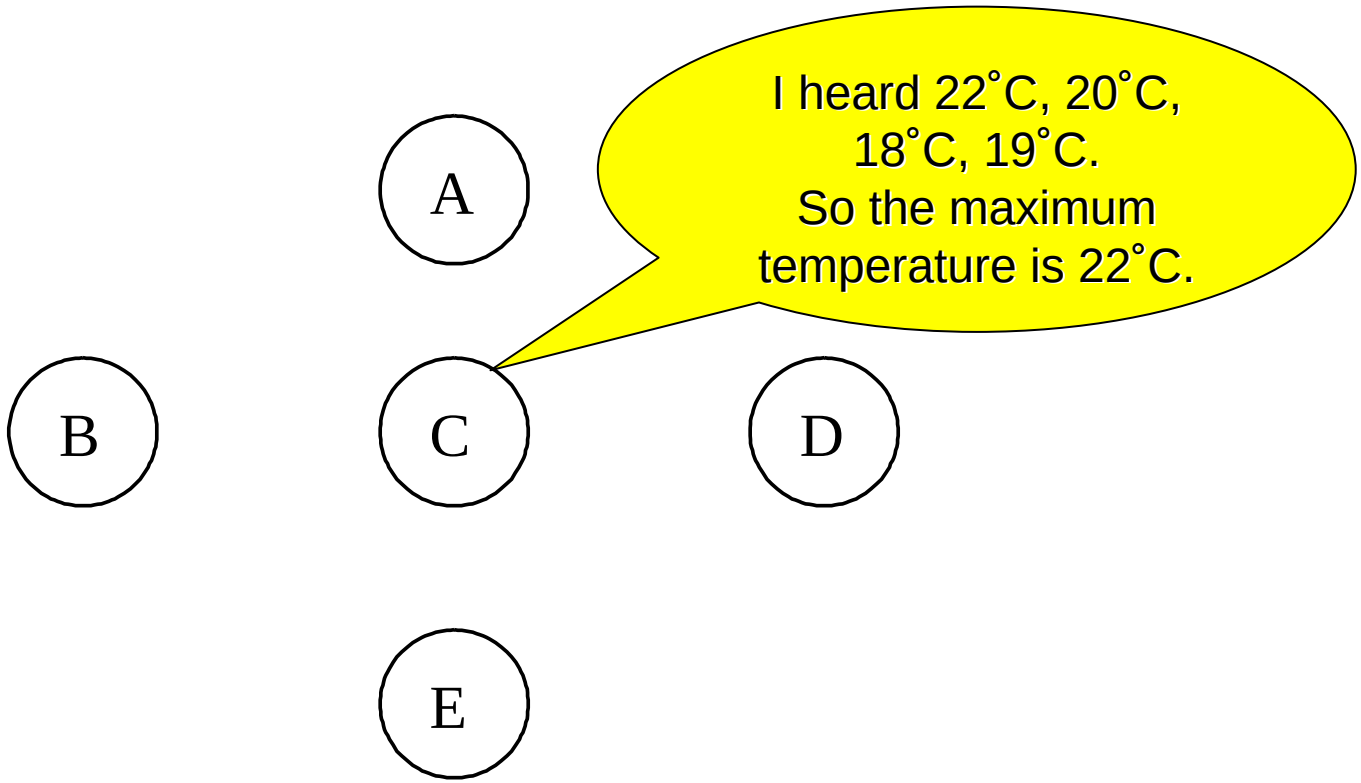
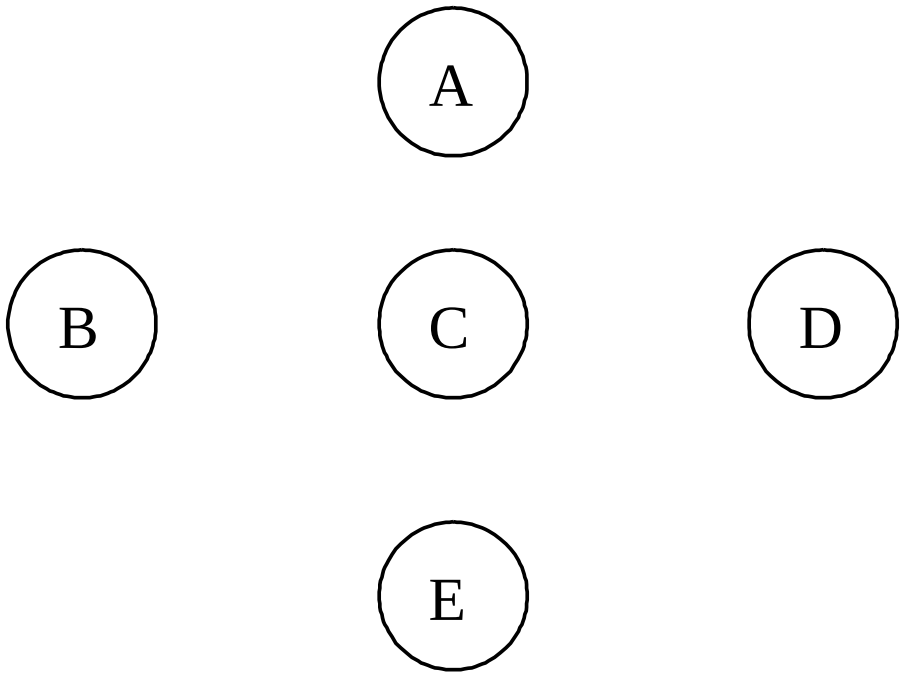


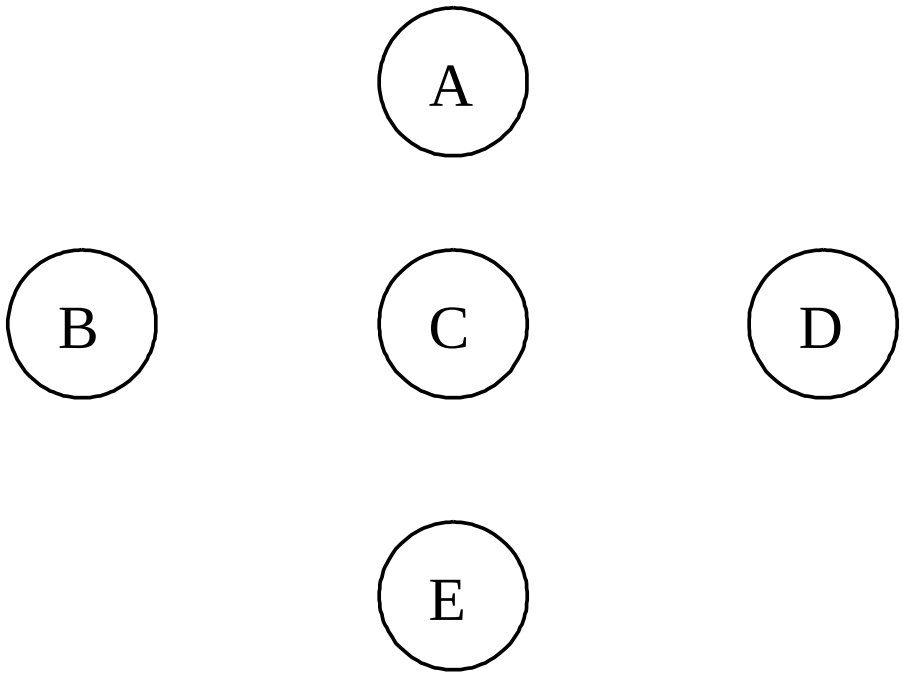
Now node C knows that max temperature is 22˚C.

Calculating the maximum temperature



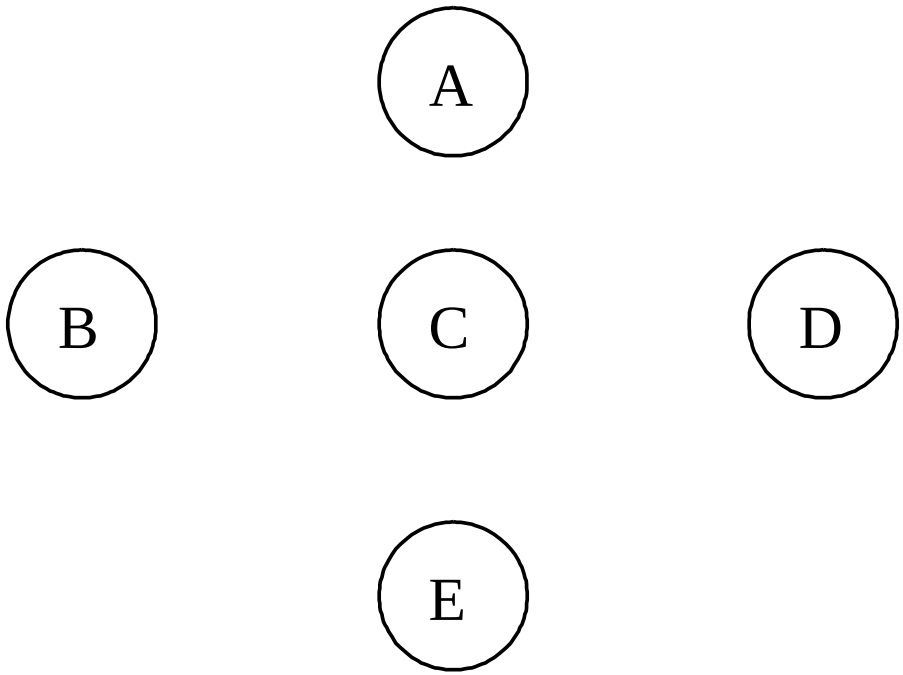
This works…

Calculating the maximum temperature



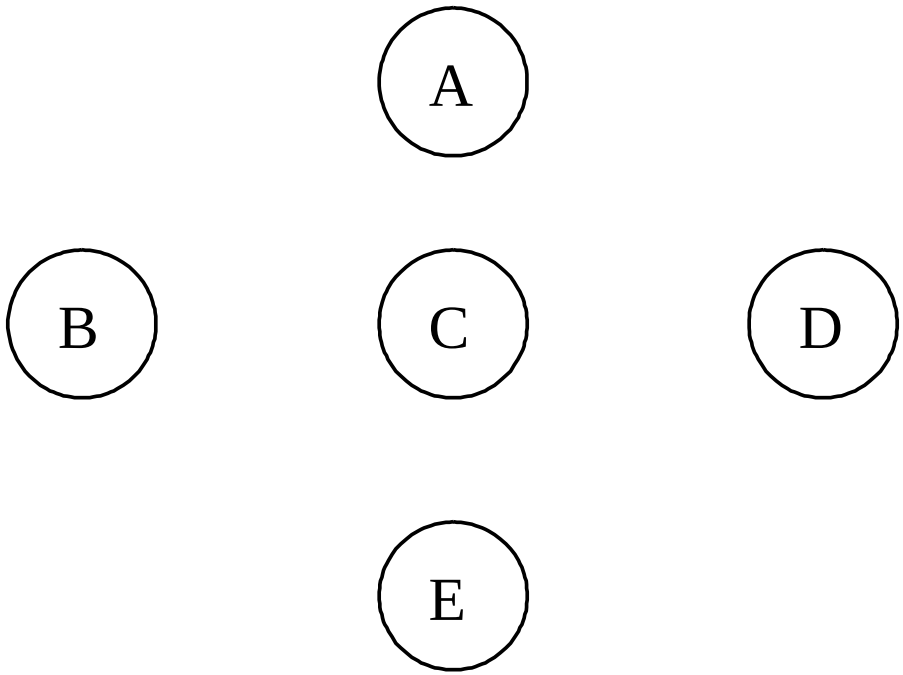
But it is slow…

Calculating the maximum temperature



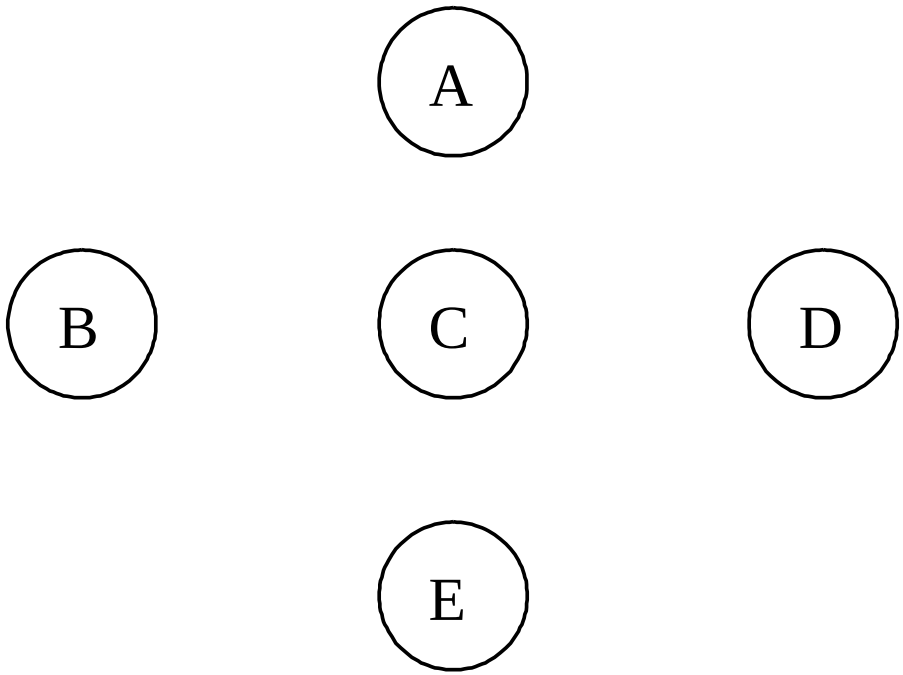
The time complexity is O(*m*), where *m* is the number of nodes

Calculating the maximum temperature



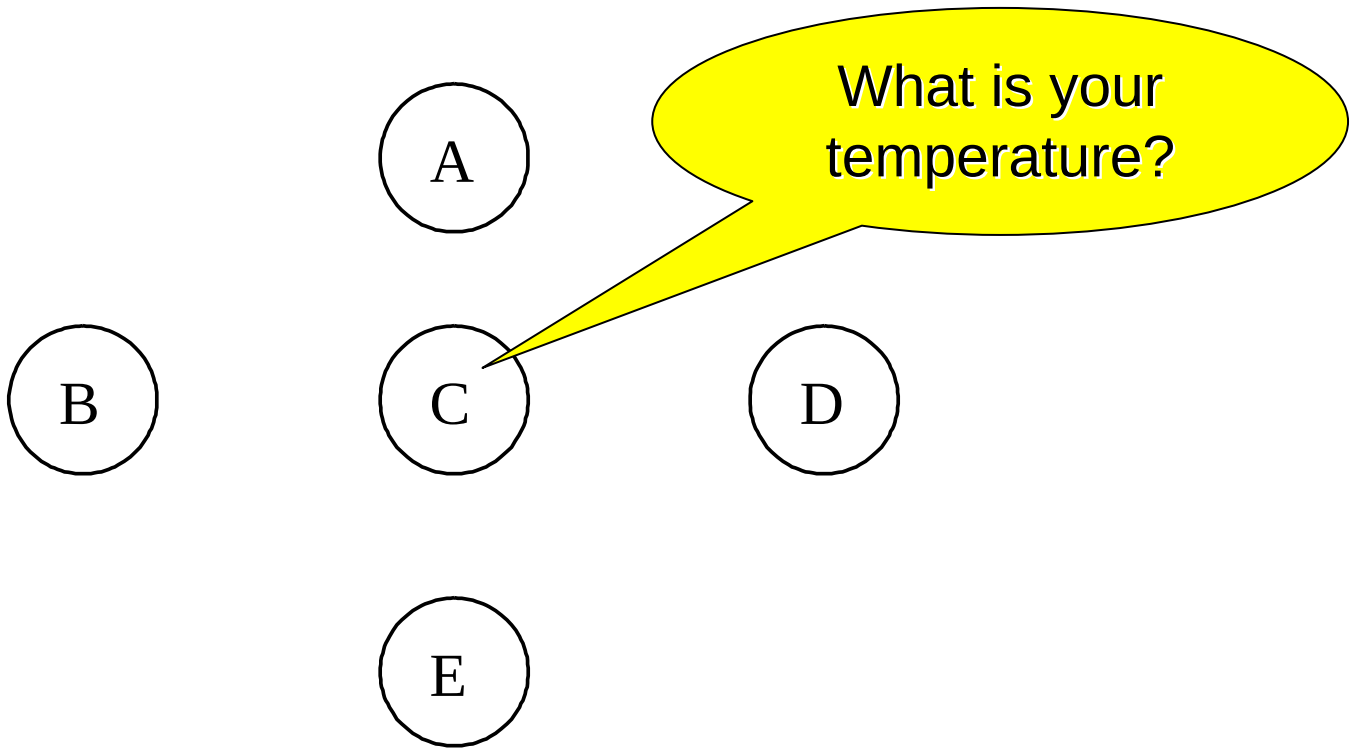
$\Rightarrow$ We need a faster way to compute the maximum temperature.

Calculating the maximum temperature



One idea…

Calculating the maximum temperature



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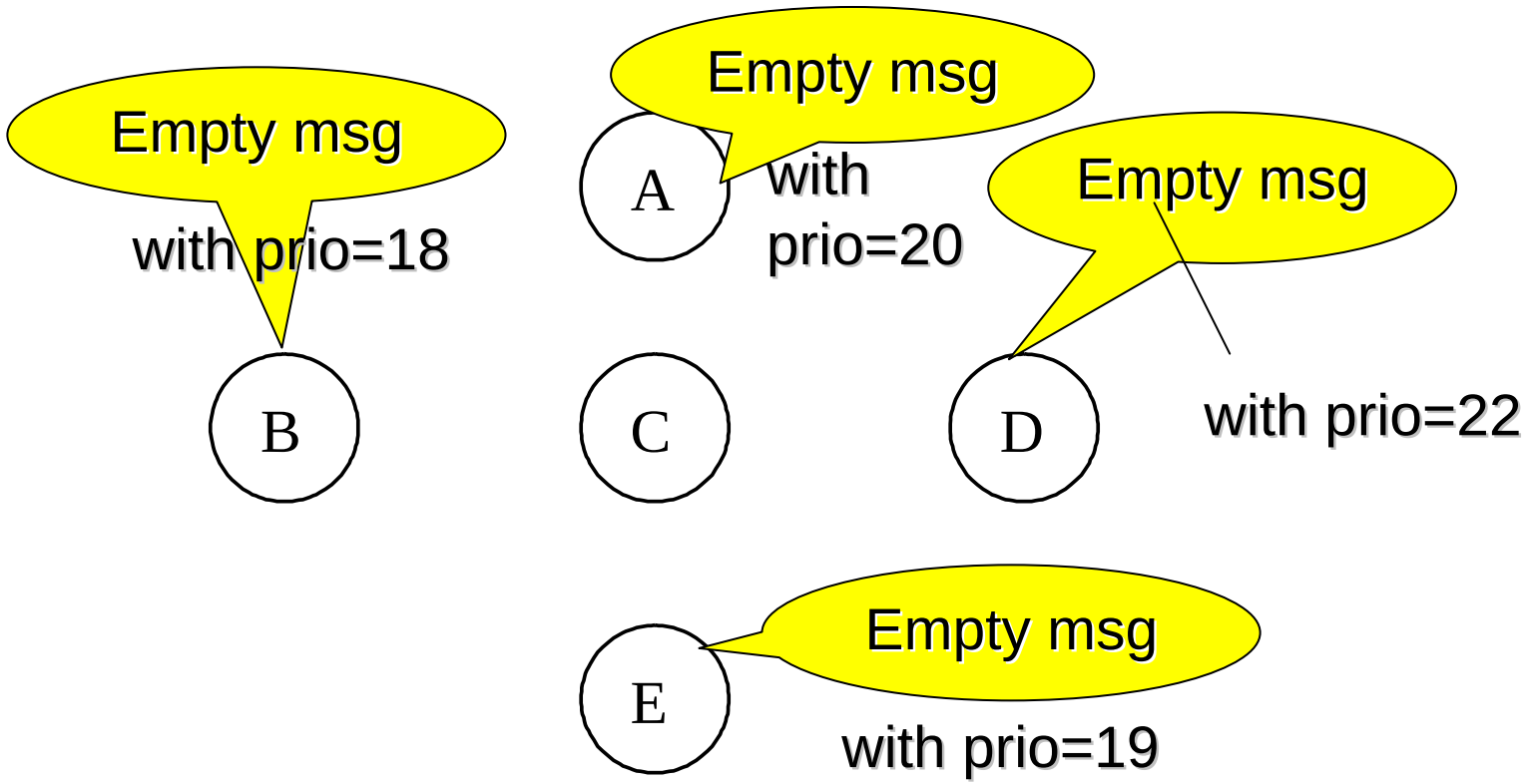
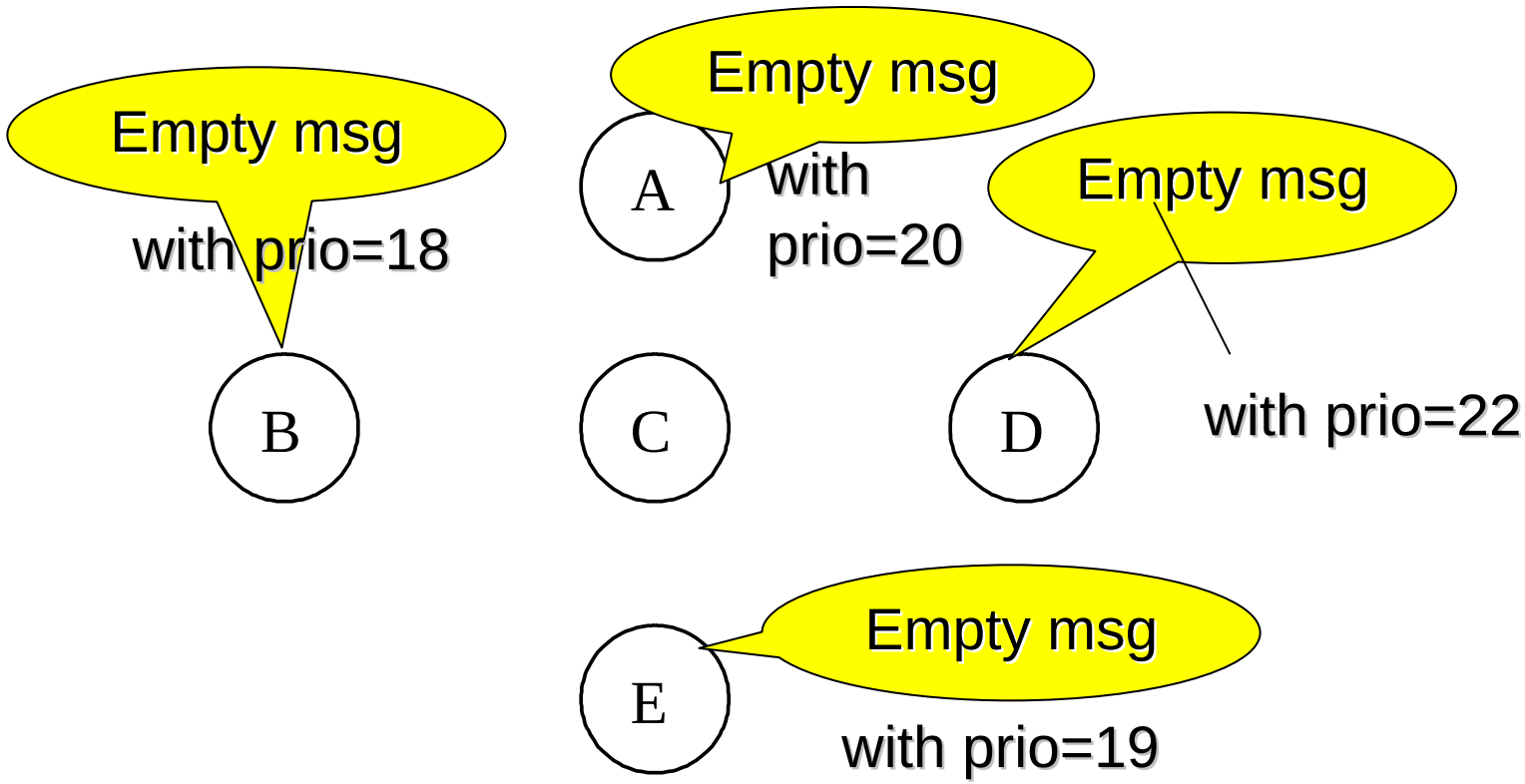
Calculating the maximum temperature



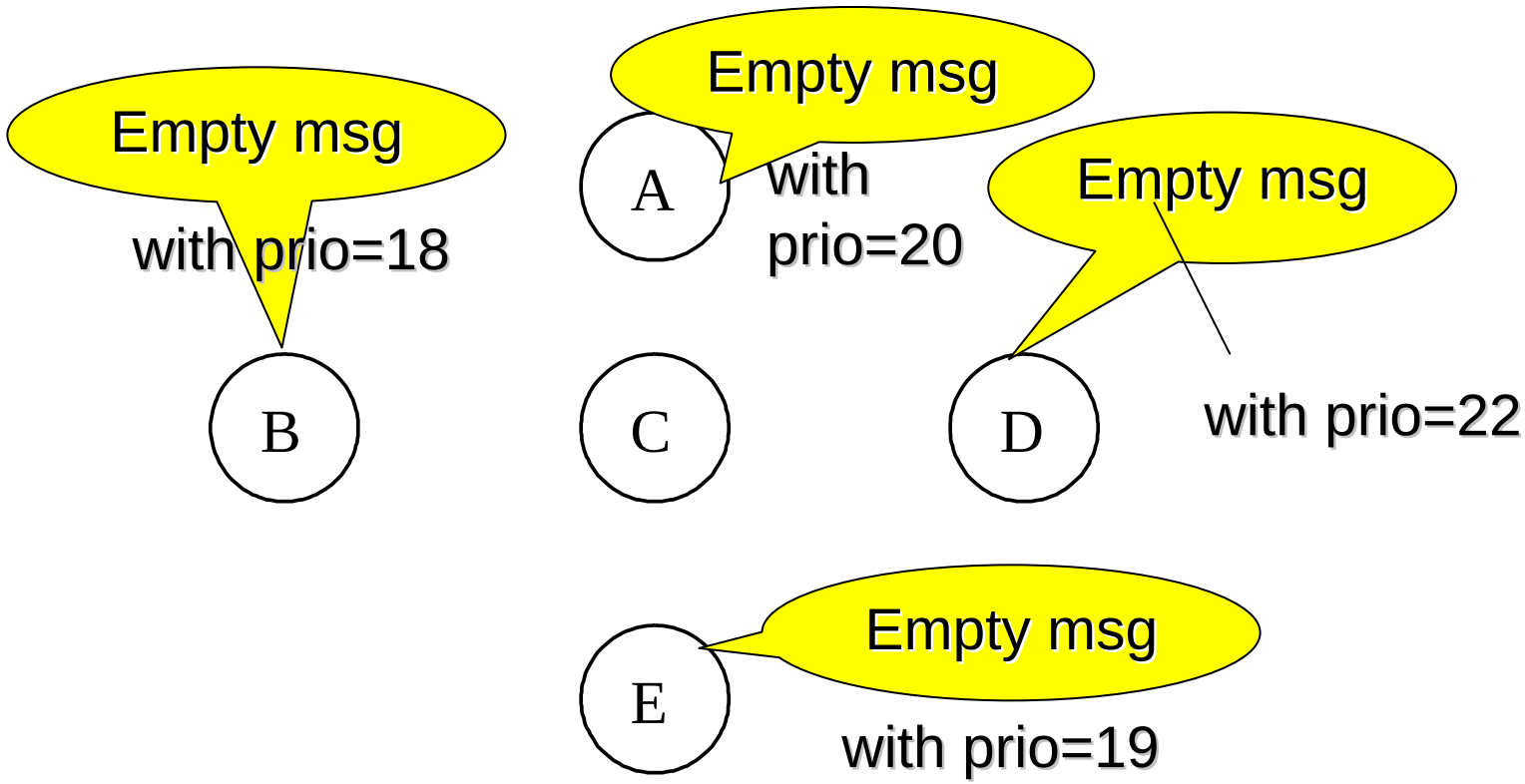
The other nodes respond in parallel…

Calculating the maximum temperature



By transmitting empty msg. The priority of the msg is given by the temperature.

Calculating the maximum temperature



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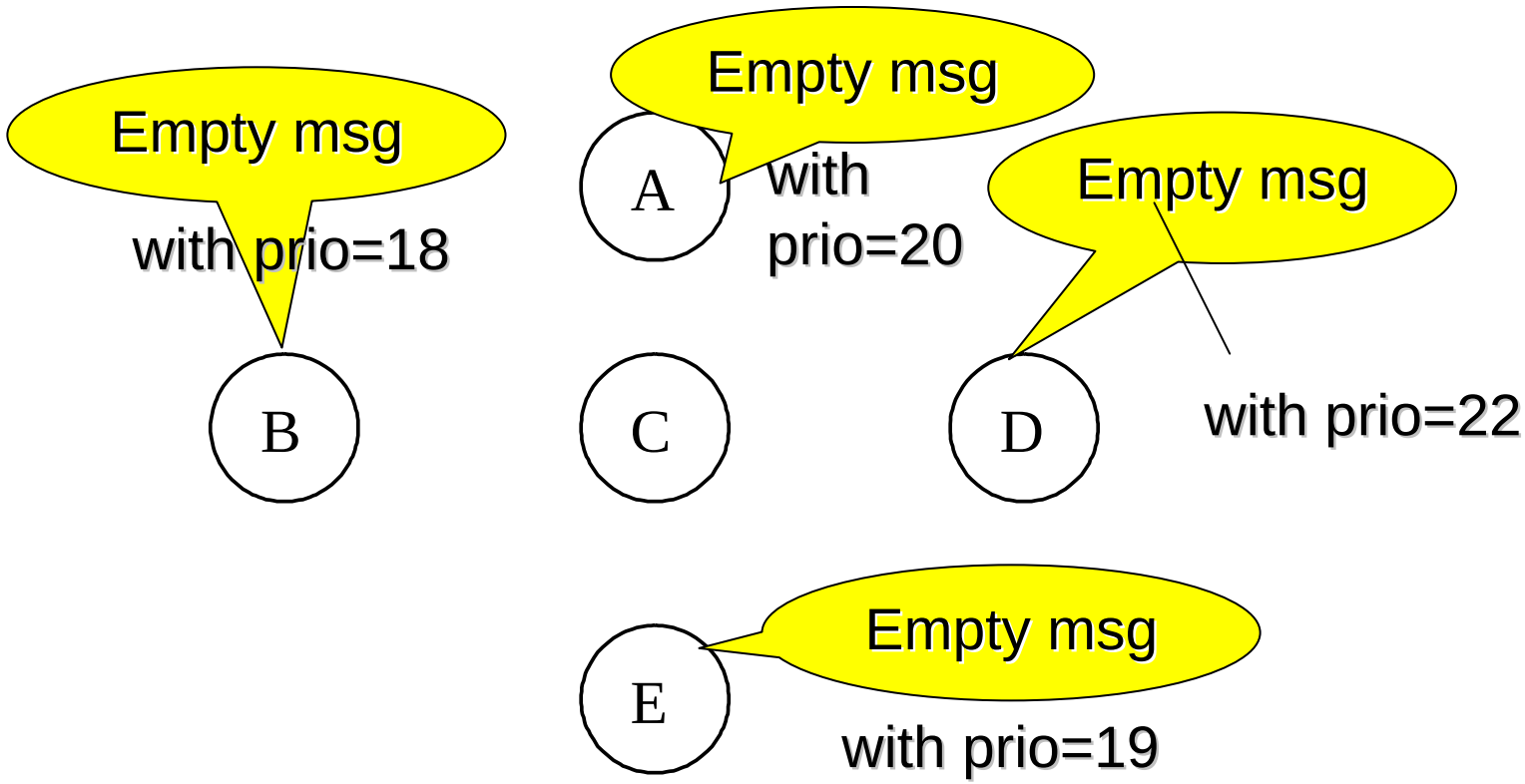
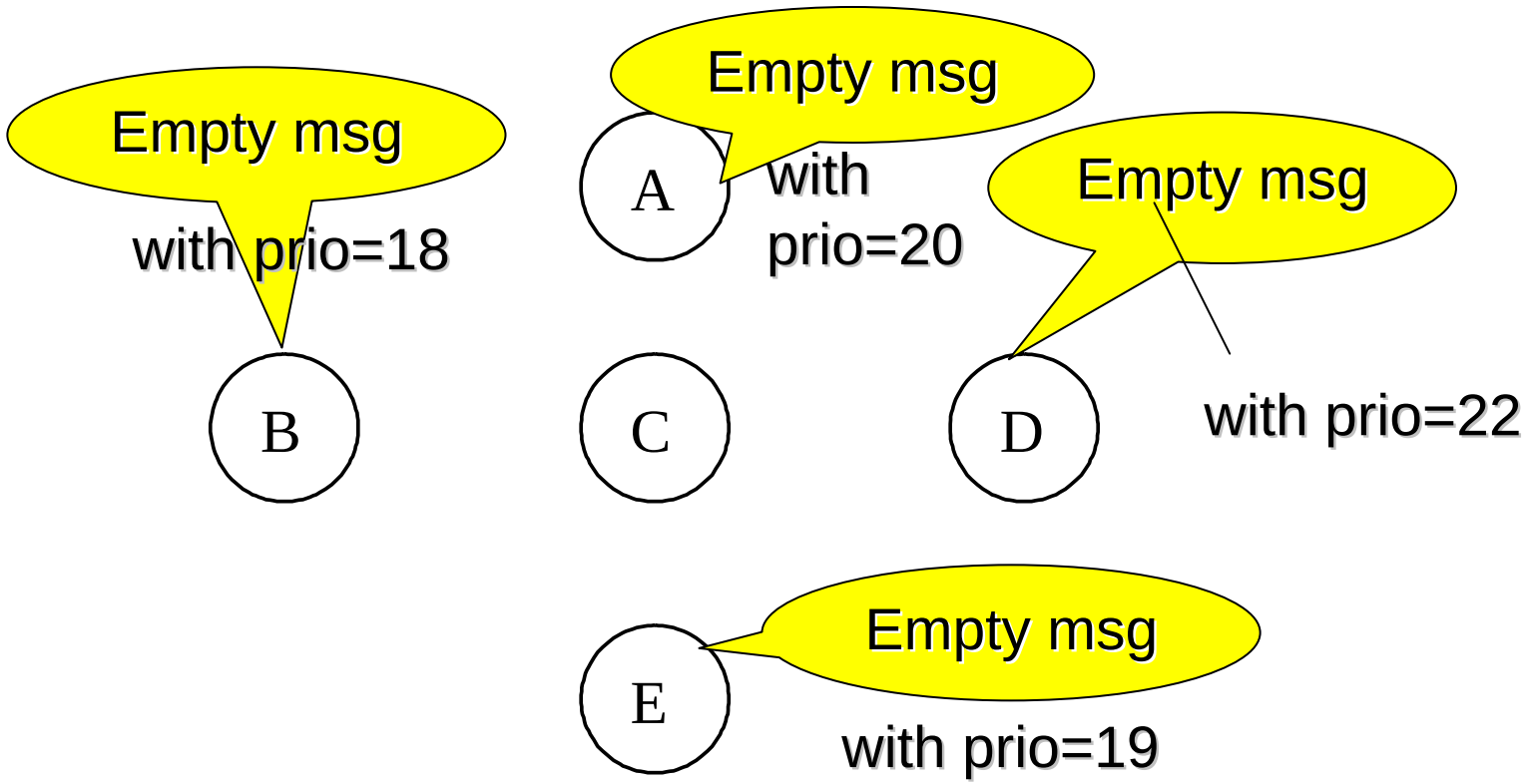


And this is faster. Time complexity in O(1).

Calculating the maximum temperature



Can we do the same trick in multihop networks?

Outline of this talk

1. Assumptions
2. The new algorithm for computing min and max in multihop networks
3. Implementation
4. Conclusions

Assumptions

There is no noise.

There are no faults in nodes.

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There are no faults in nodes.

All nodes run a prioritized MAC protocol (similar to CAN).

The MAC protocol has a large number of priorities (similar to CAN)

low priority number = high priority (similar to CAN)

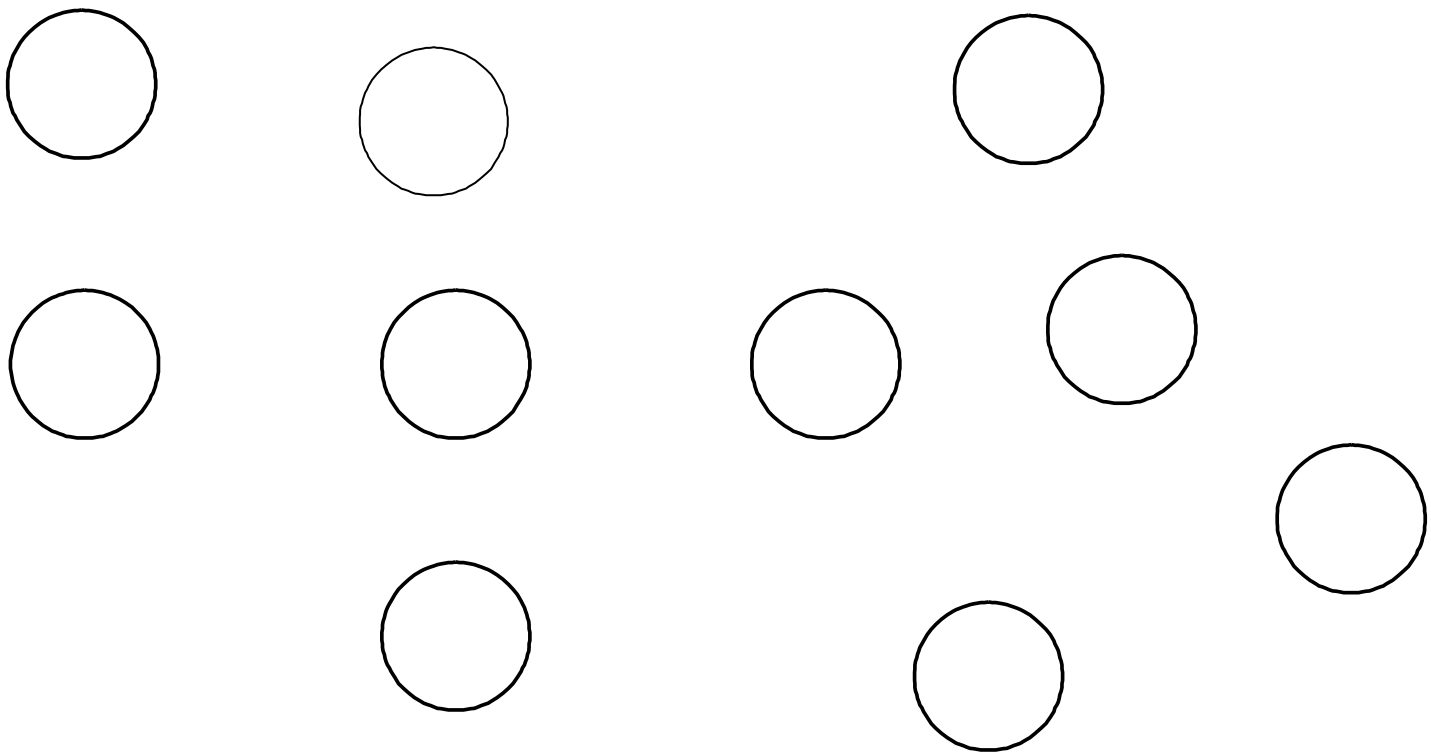
Assumptions

The MAC protocol performs a tournament and selects the highest priority nodes (the one with the lowest priority number) (similar to CAN).

Before the tournament, the MAC protocol synchronizes the nodes (similar to CAN)

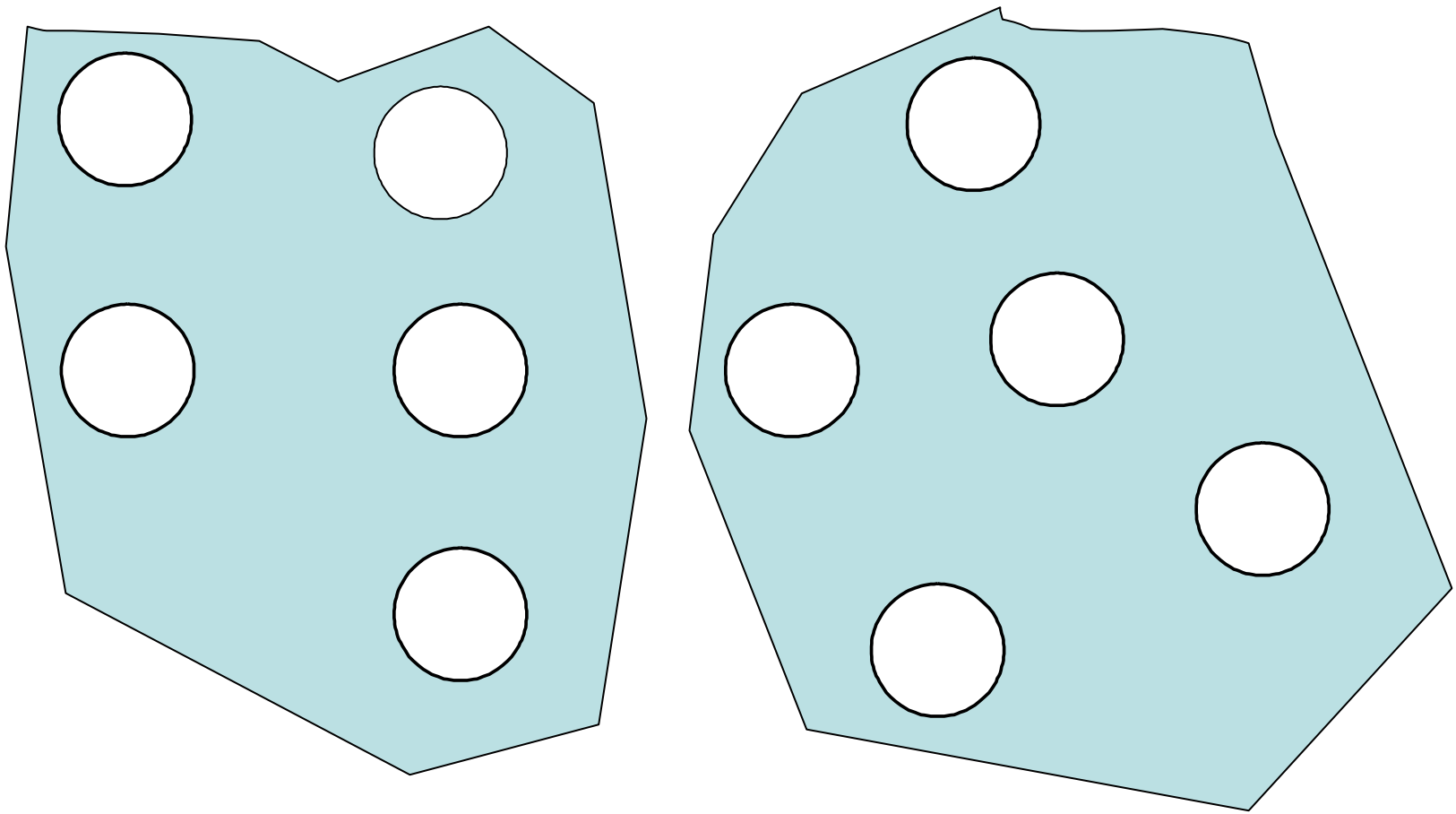
The new algorithm

An example of a multihop network



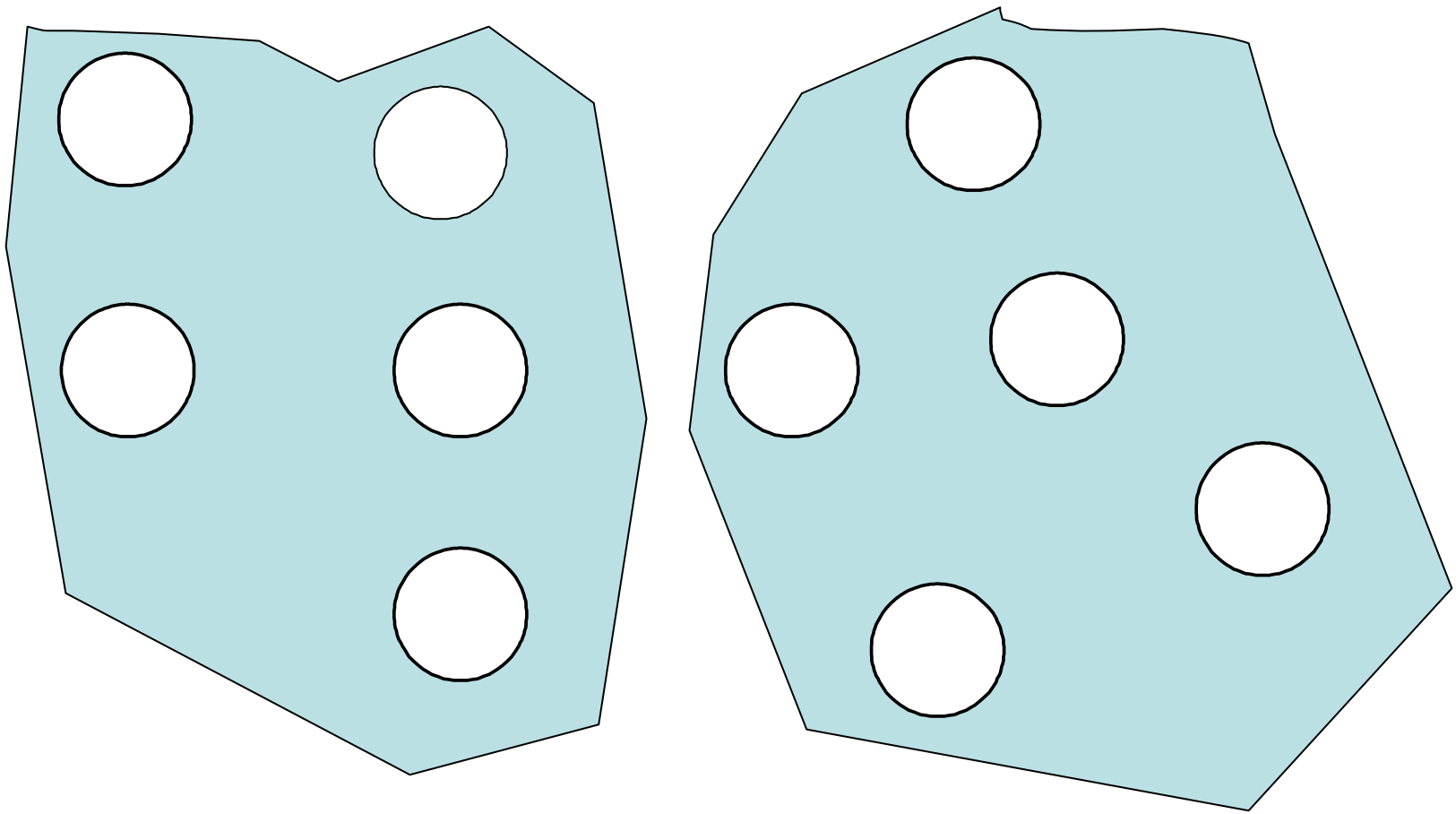
The new algorithm

Let us partition the set of computer nodes…



The new algorithm

… such that each partition constitute a broadcast domain.



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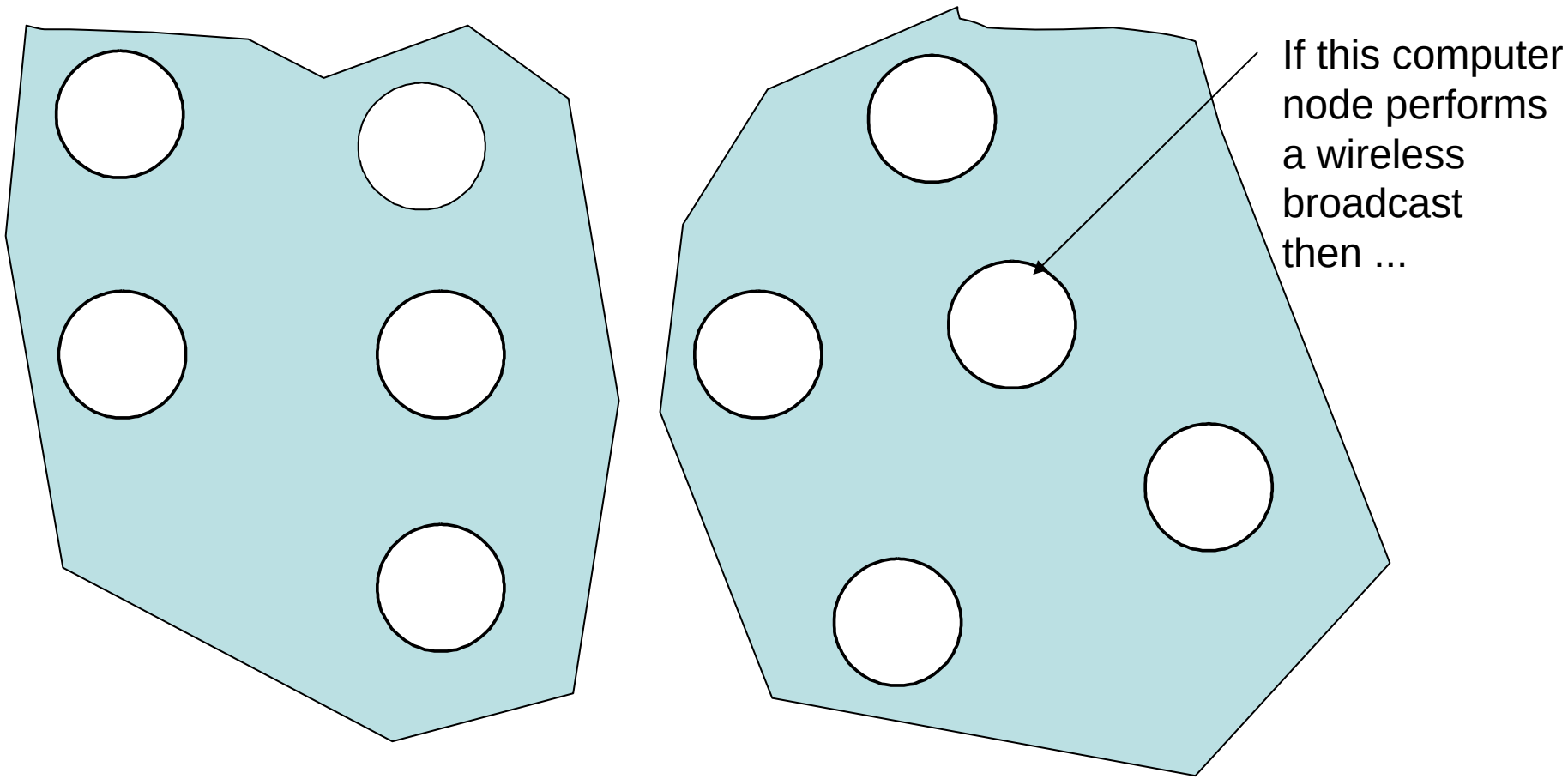

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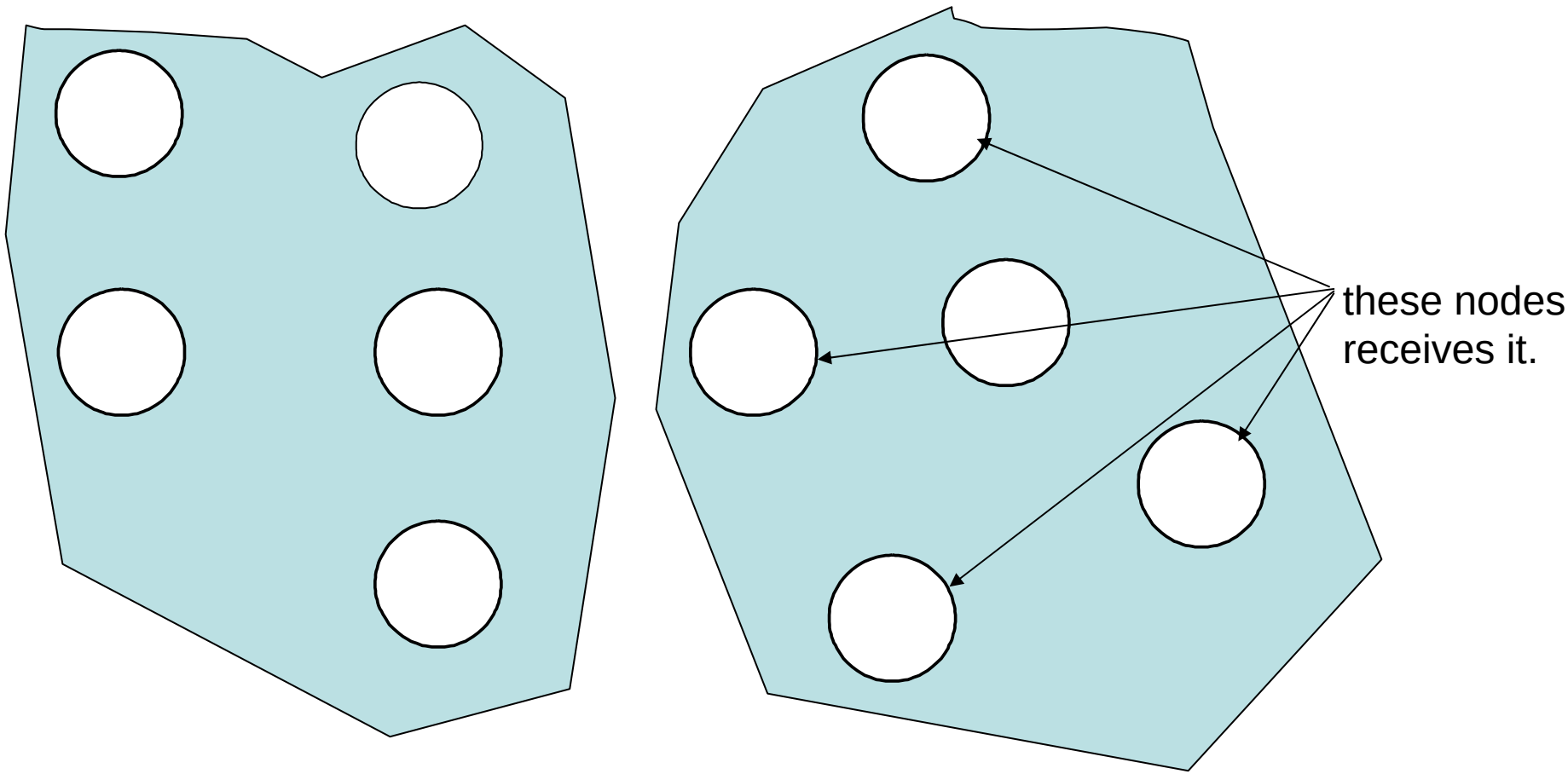
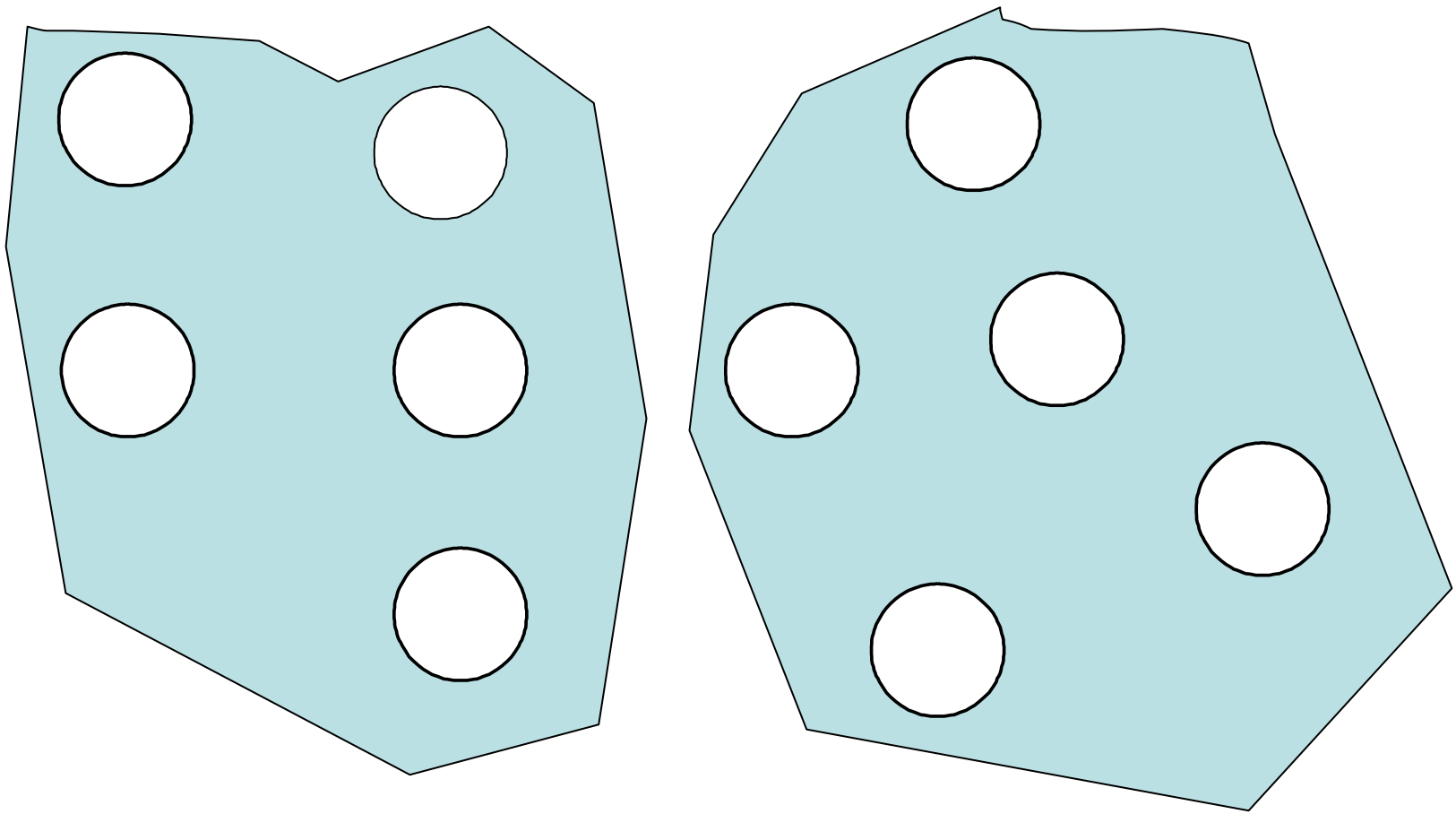


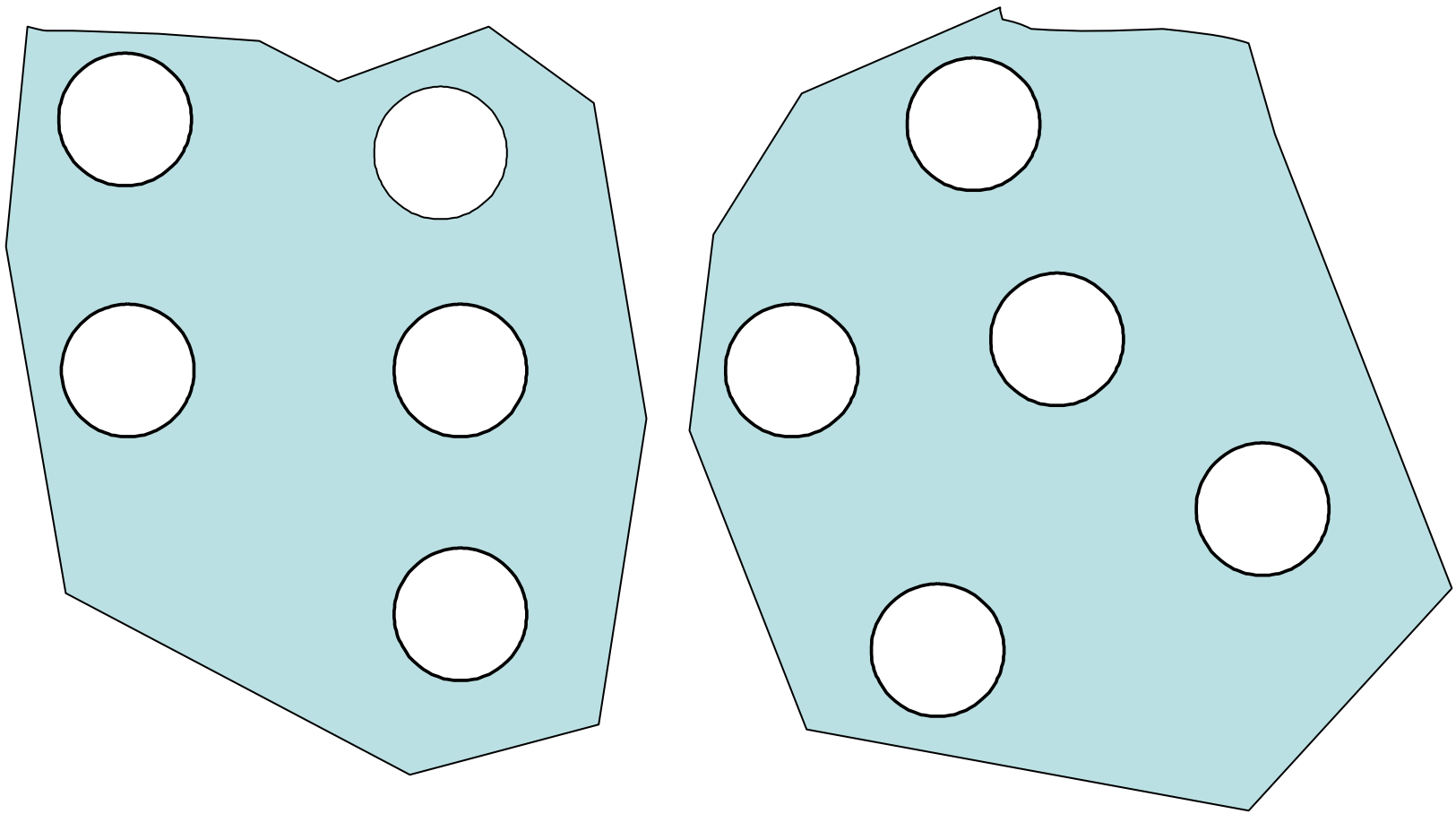
The new algorithm

Idea 2. Use the algorithm for computing MIN in each broadcast domain.



The new algorithm

Idea 2. And combine the results in each partition.

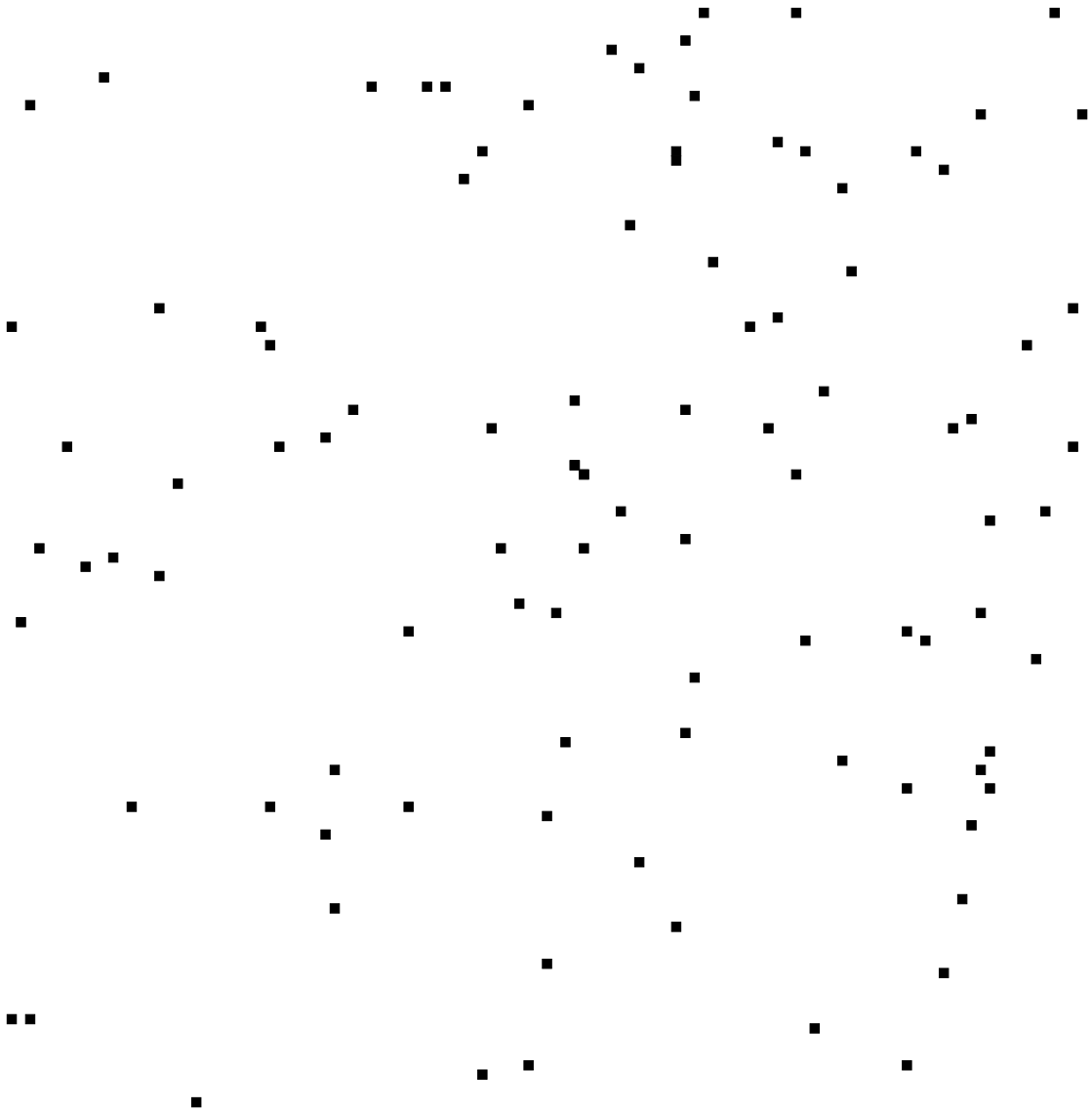


The new algorithm

A running example. What do to before run-time

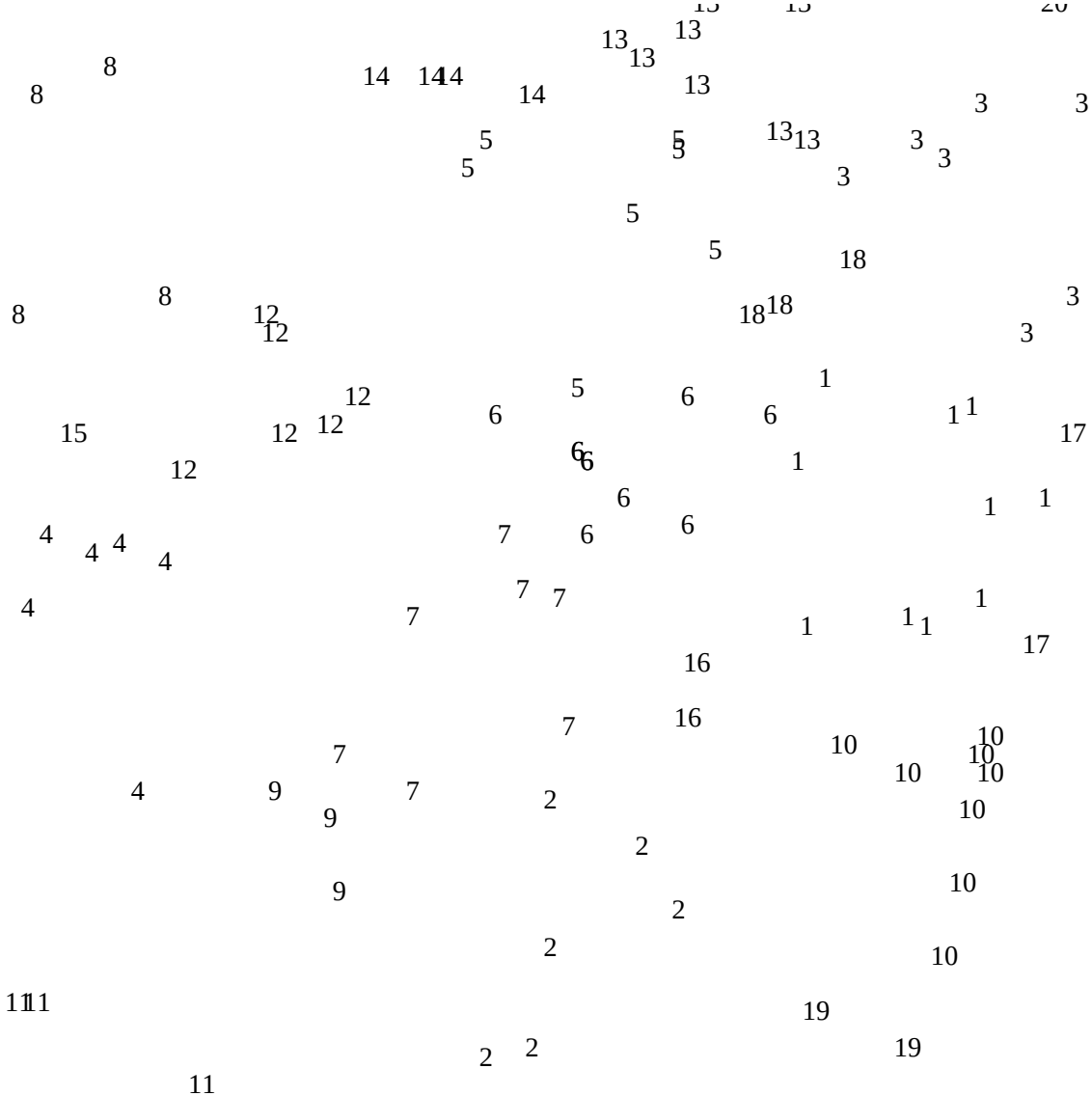
The new algorithm

The positions of nodes



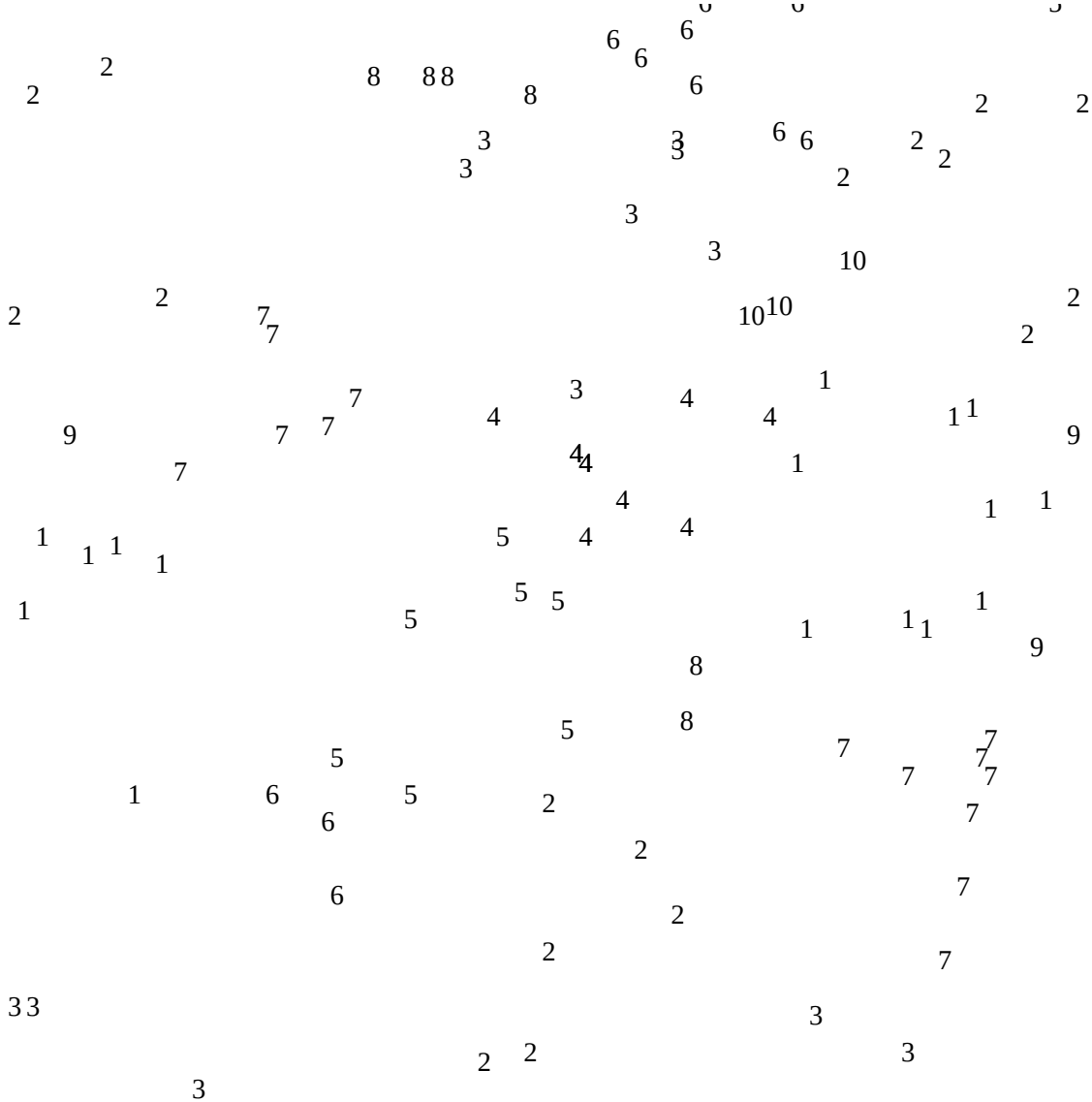
The new algorithm

The partition ids of nodes



The new algorithm

Time slot ids of nodes

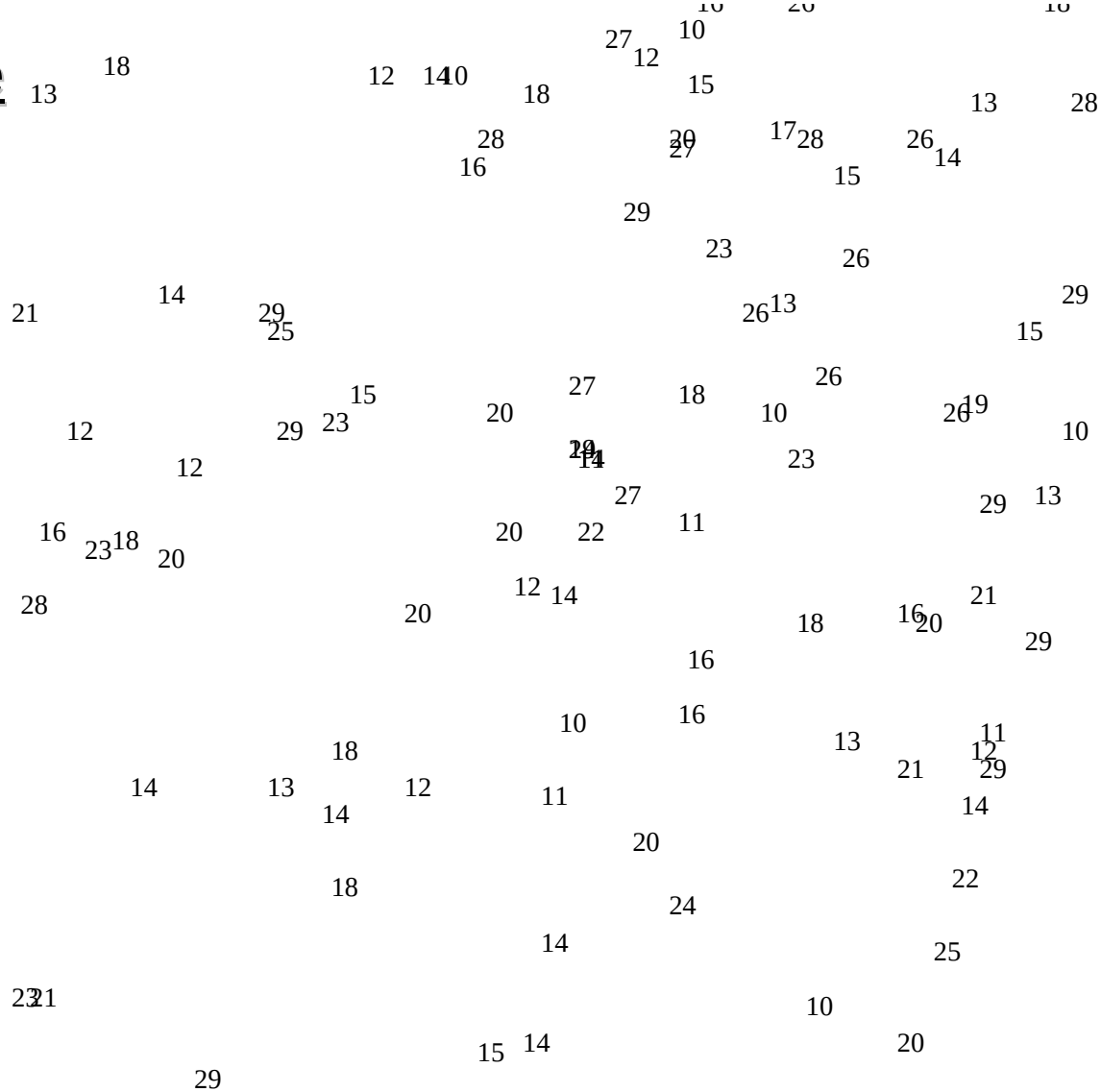


The new algorithm

A running example. What to do at run-time

The new algorithm

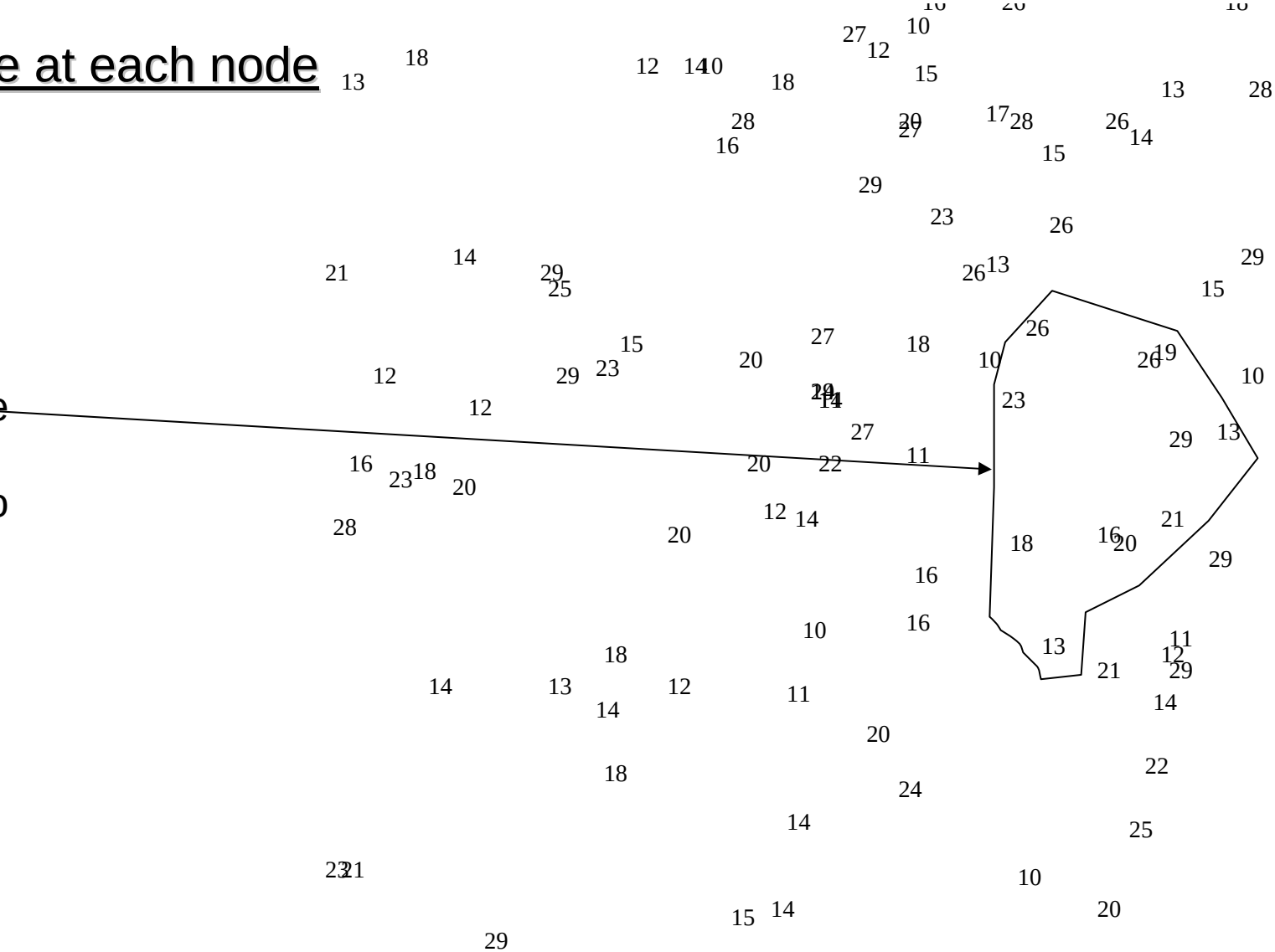
Temperature at each node



The new algorithm

Temperature at each node

Here is one partition assigned to time slot 1.



The new algorithm

Temperature at each node after time slot 1.

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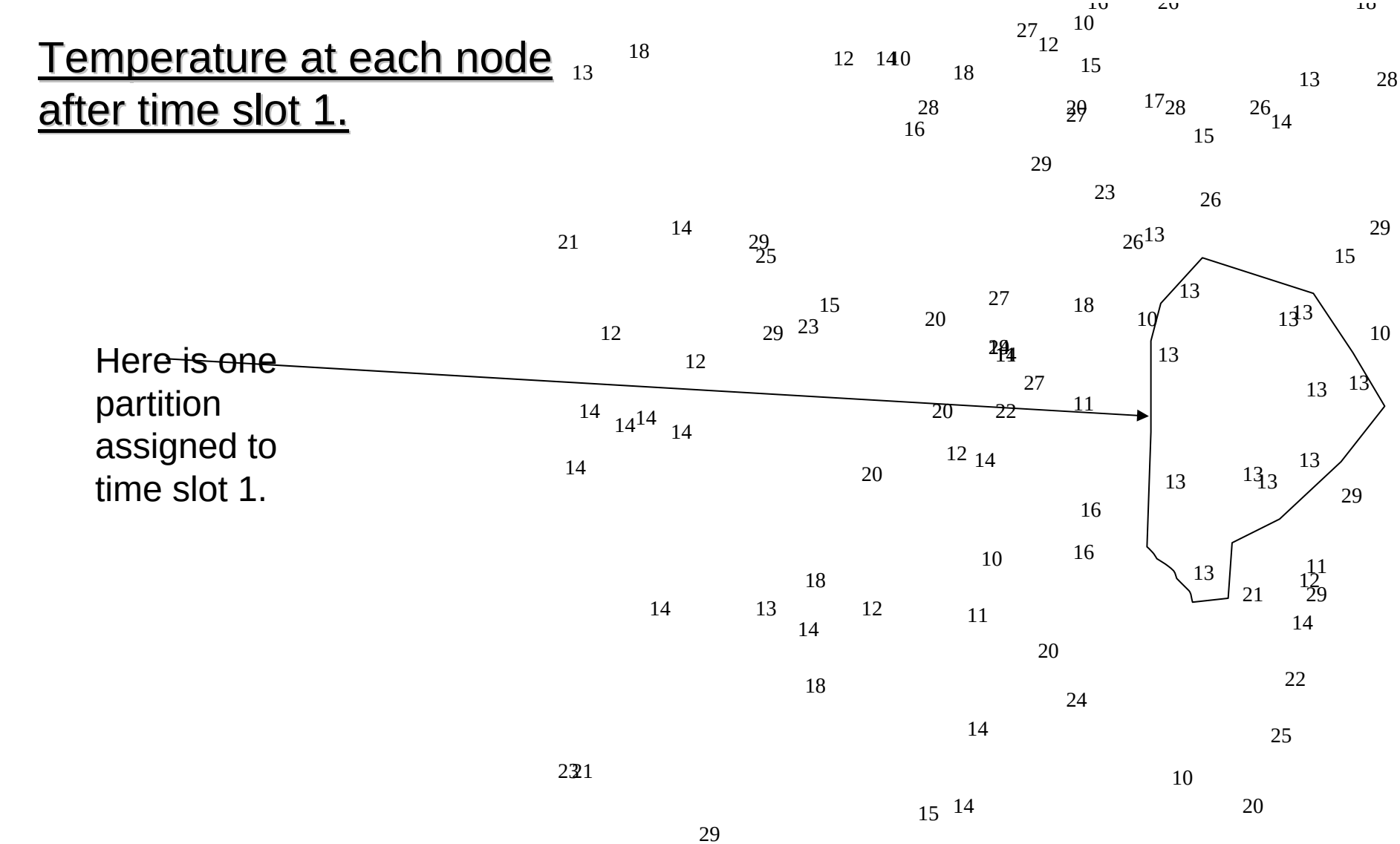
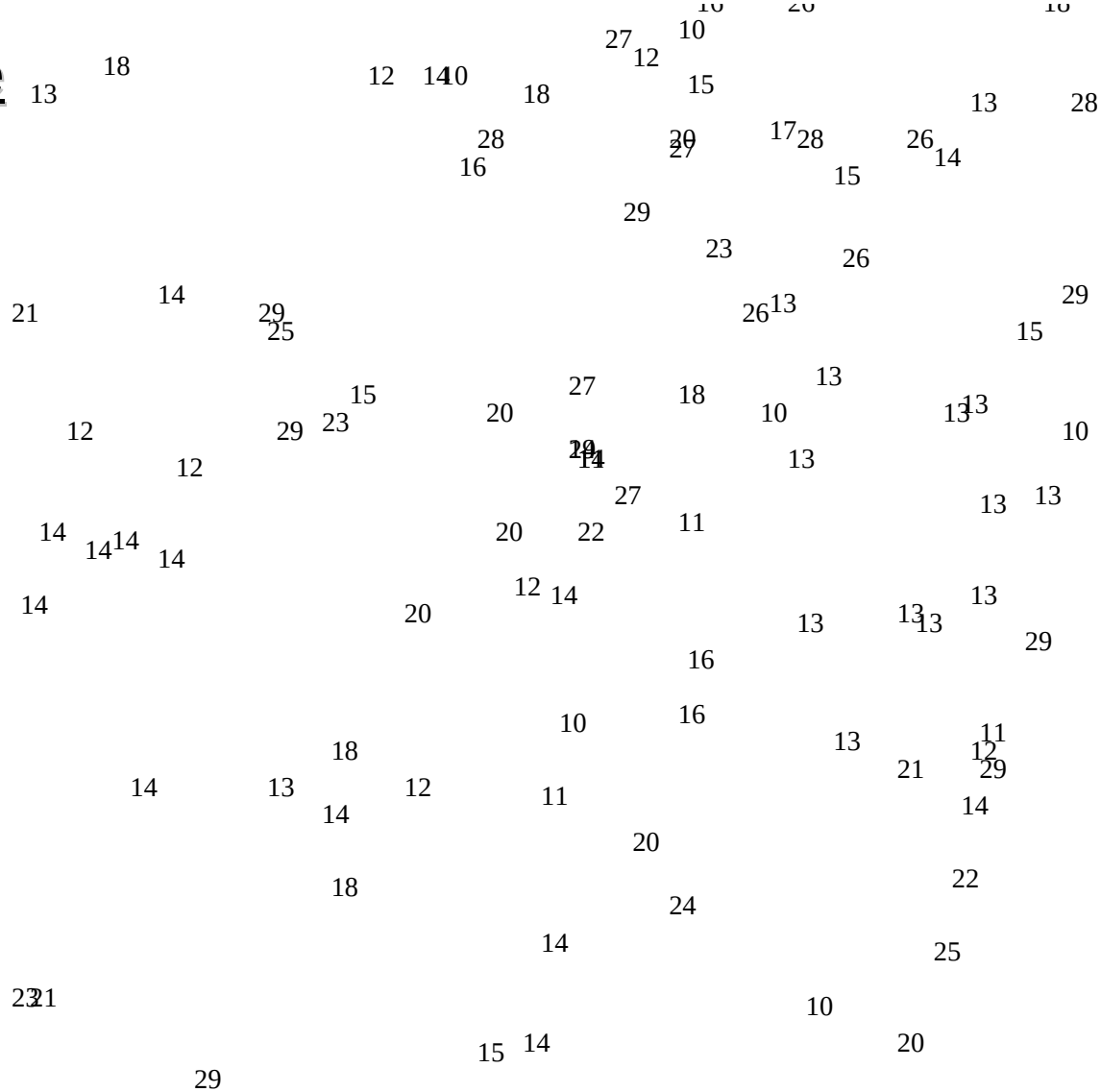


The new algorithm

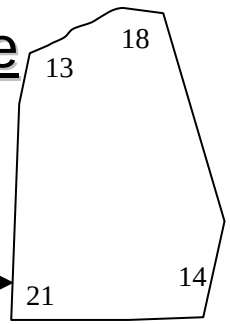
Temperature at each node before time slot 2.



The new algorithm

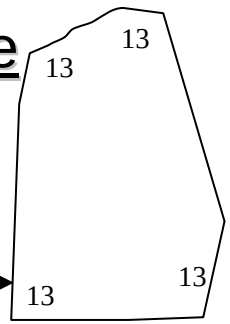
Temperature at each node before time slot 2.

Here is one partition assigned to time slot 2.



The new algorithm

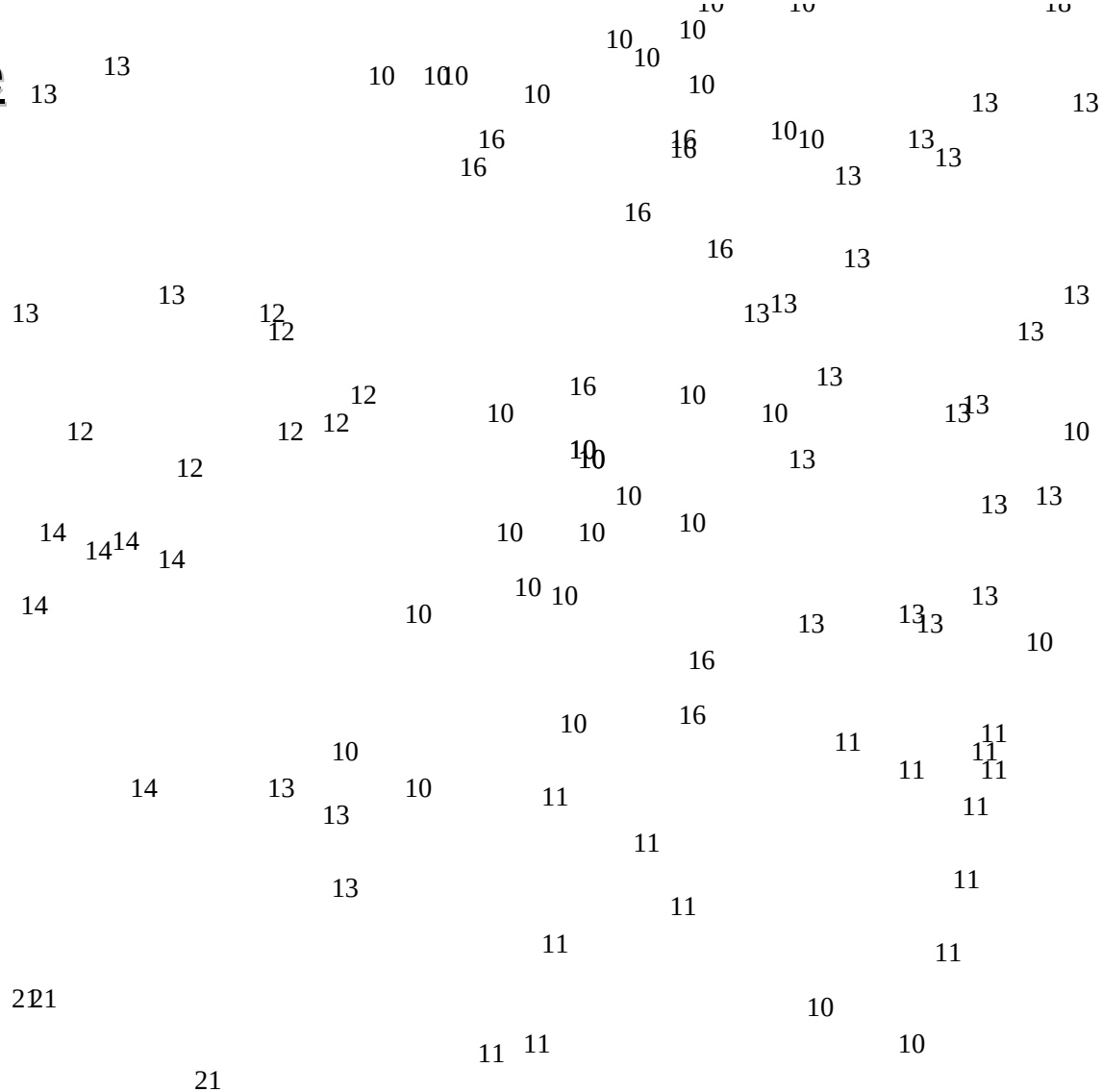
Temperature at each node after time slot 2.



Here is one partition assigned to time slot 2.

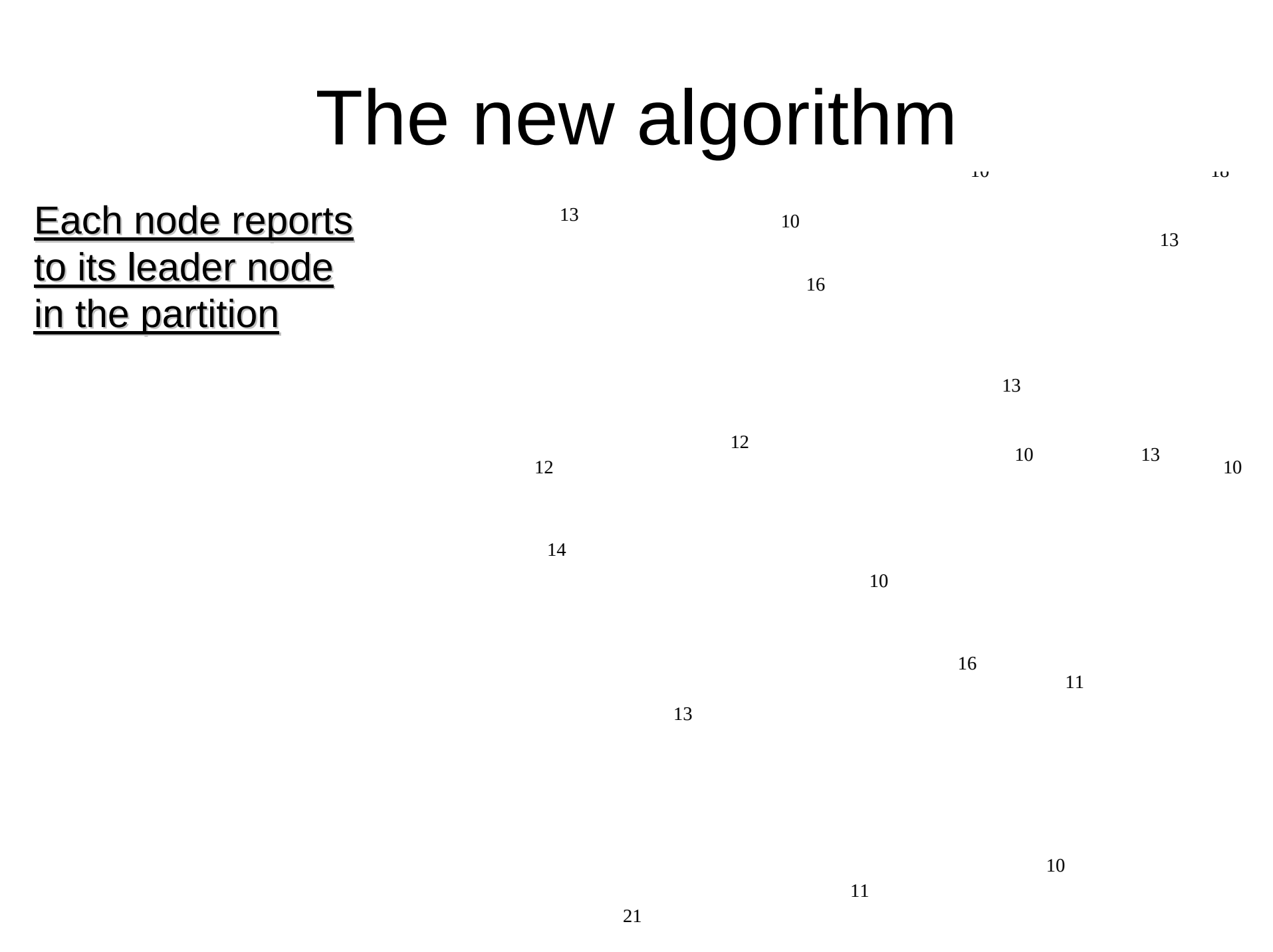
The new algorithm

Temperature at each node after time slot 10.



The new algorithm

Each node reports to its leader node in the partition



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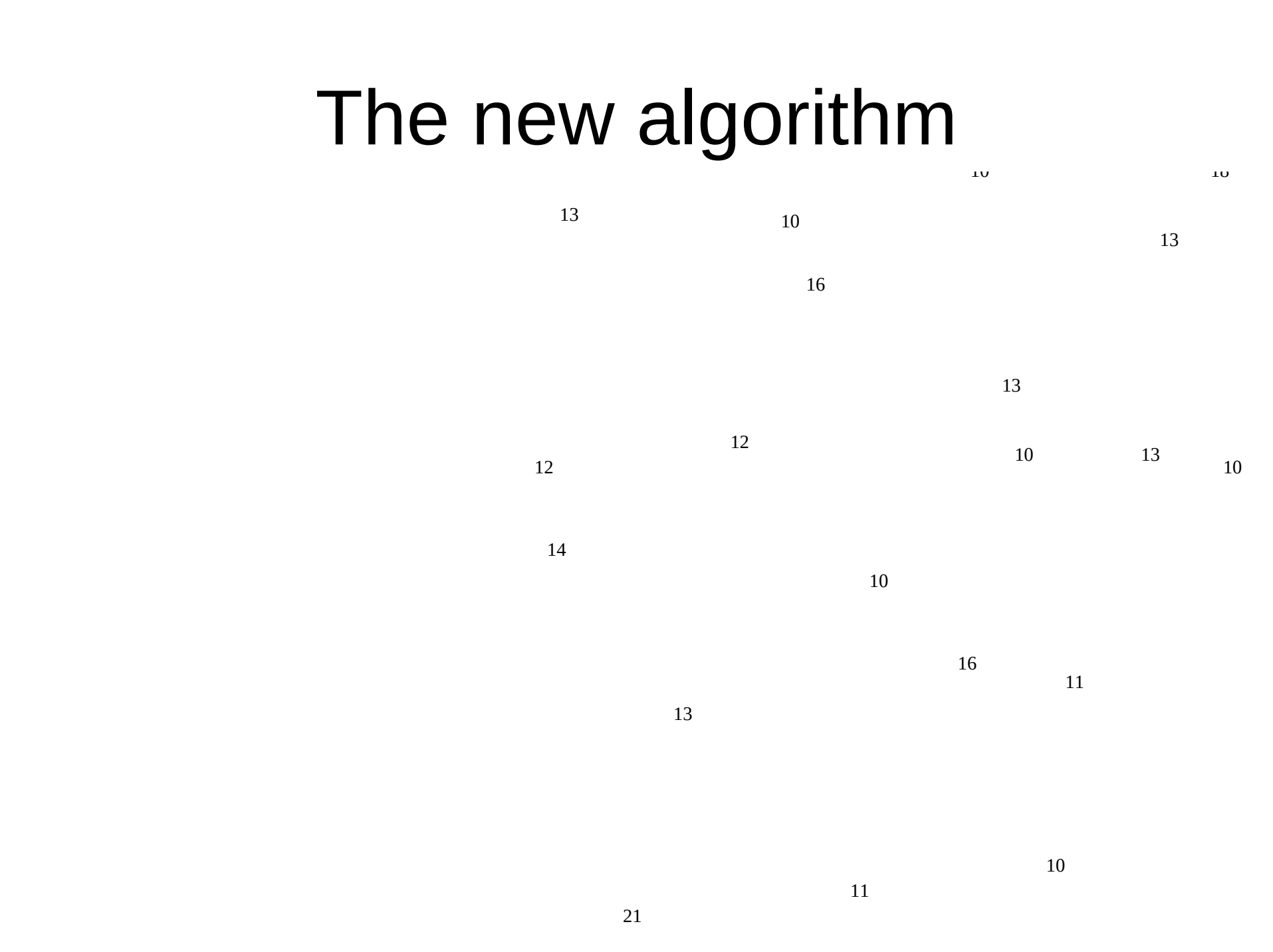

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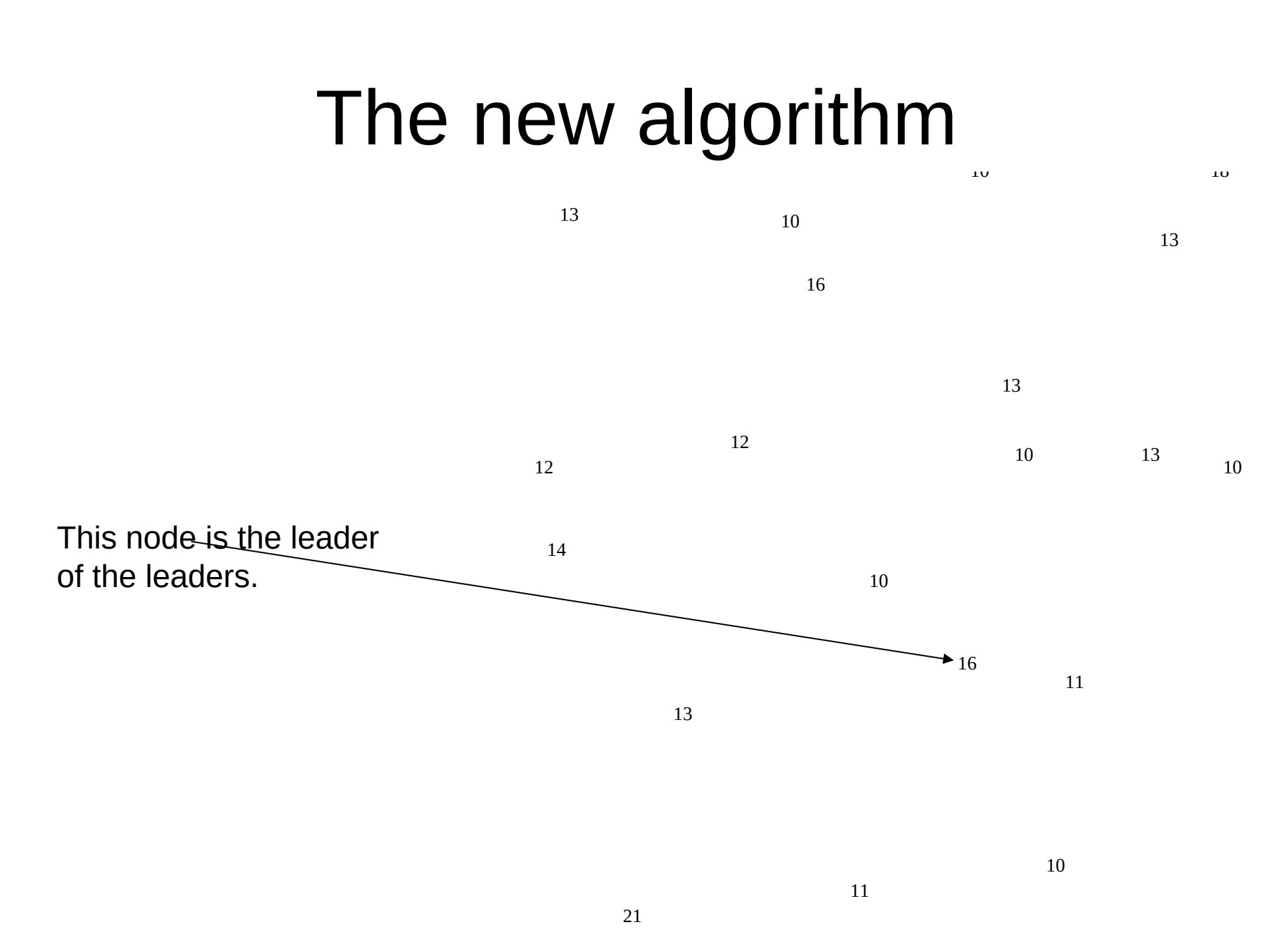

The new algorithm

Implementation

Q: Does this algorithm work in practice?

Implementation

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Algorithm for efficiently computing MIN in a single broadcast domain:

A: Yes it works.

Algorithm for efficiently computing MIN in multihop networks:

A: Not yet implemented.

Conclusions

It is possible to compute min and max efficiently in multihop networks.

Thanks for you attention!

Questions?