Self-Management of Large Scale Distributed Systems

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23^{th} Jan, 2009

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WARNING!

No jokes nor hot chicks on this presentation

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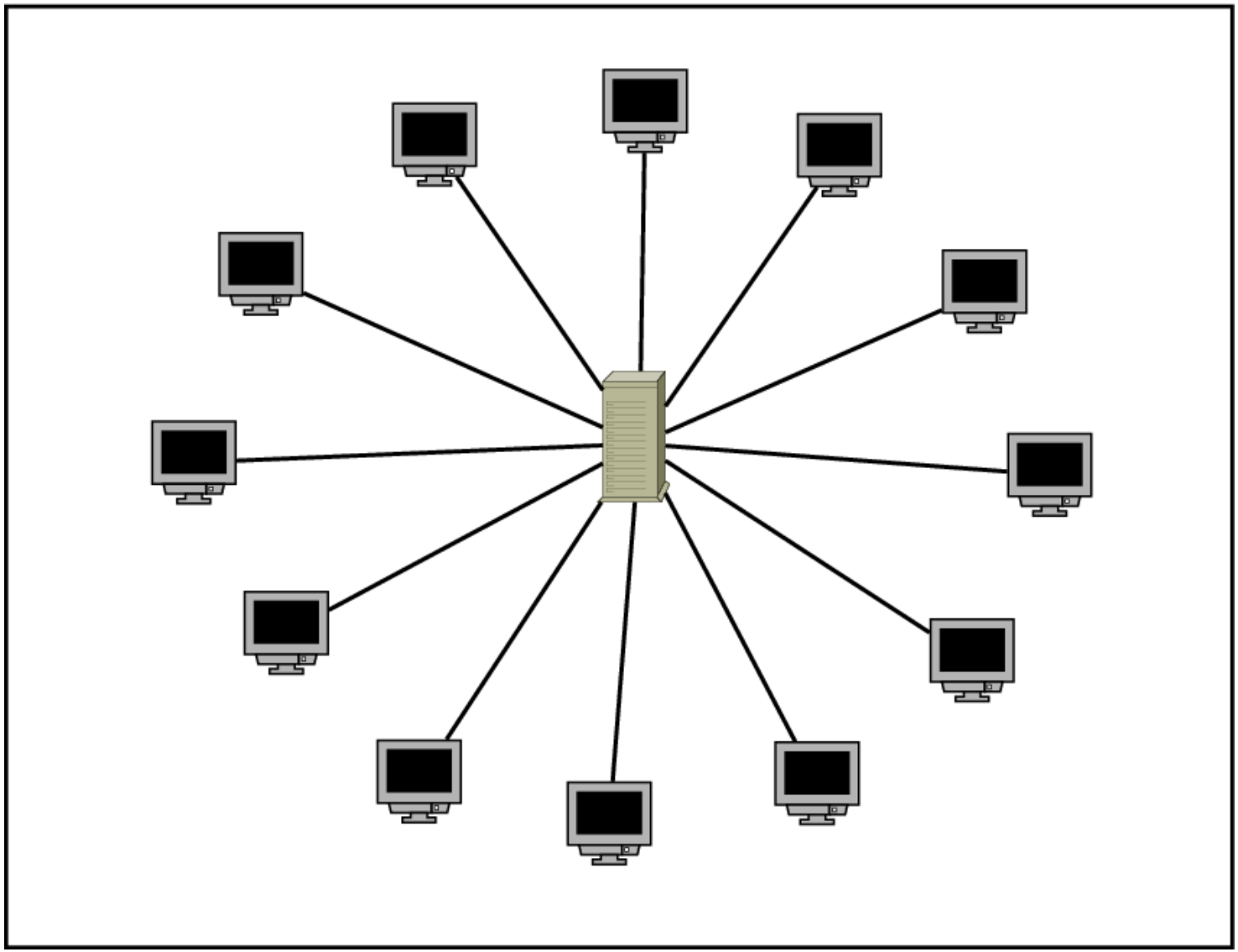

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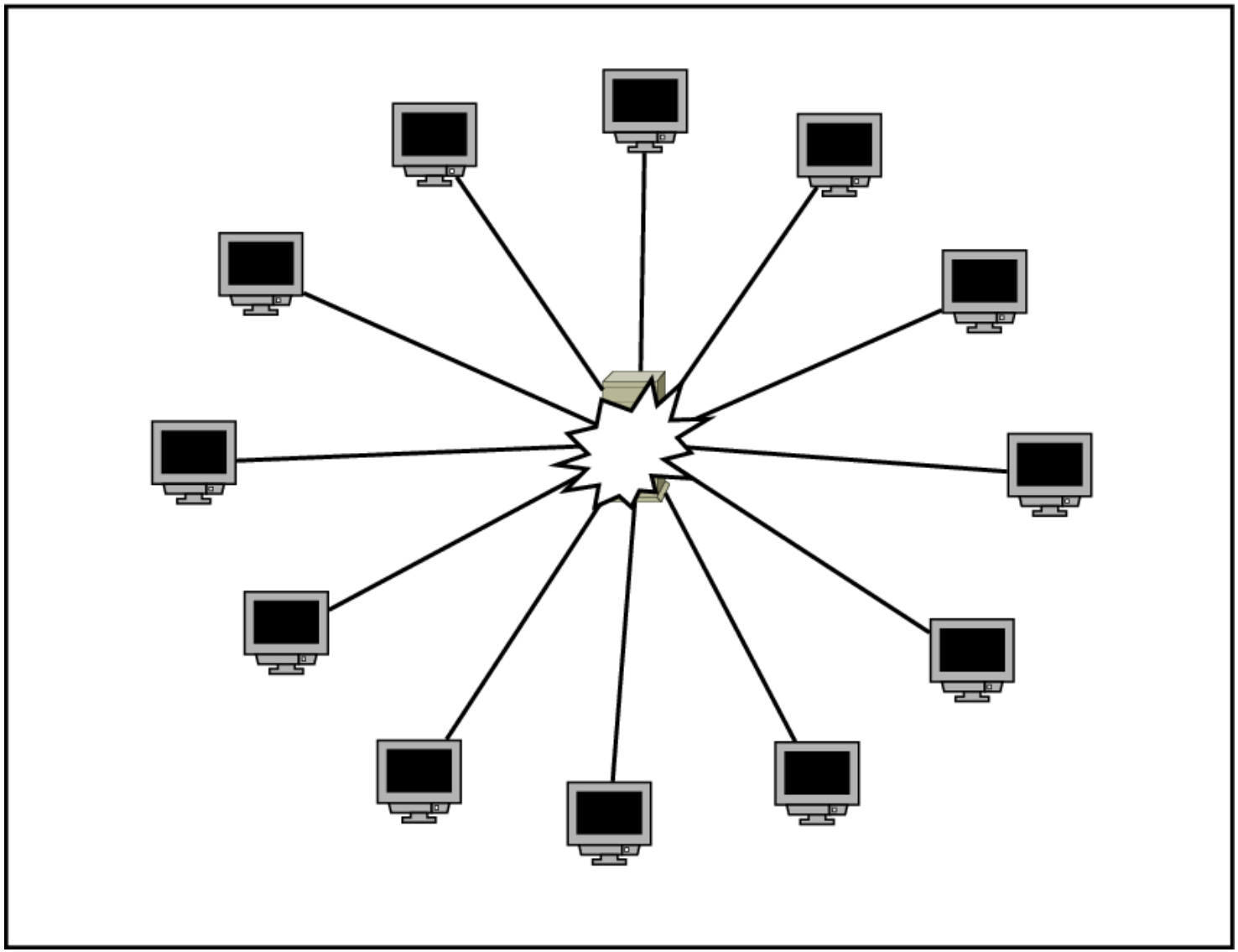

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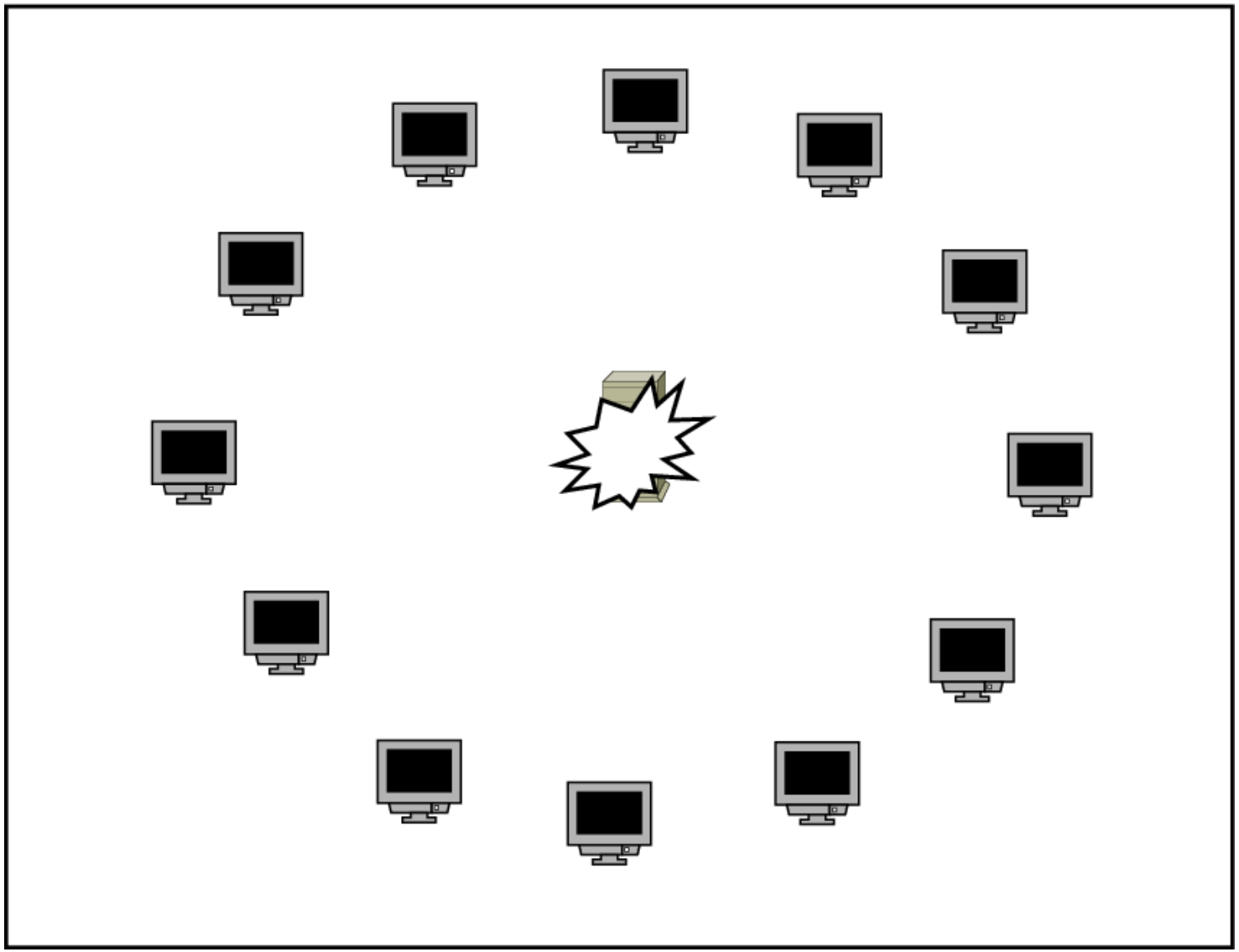

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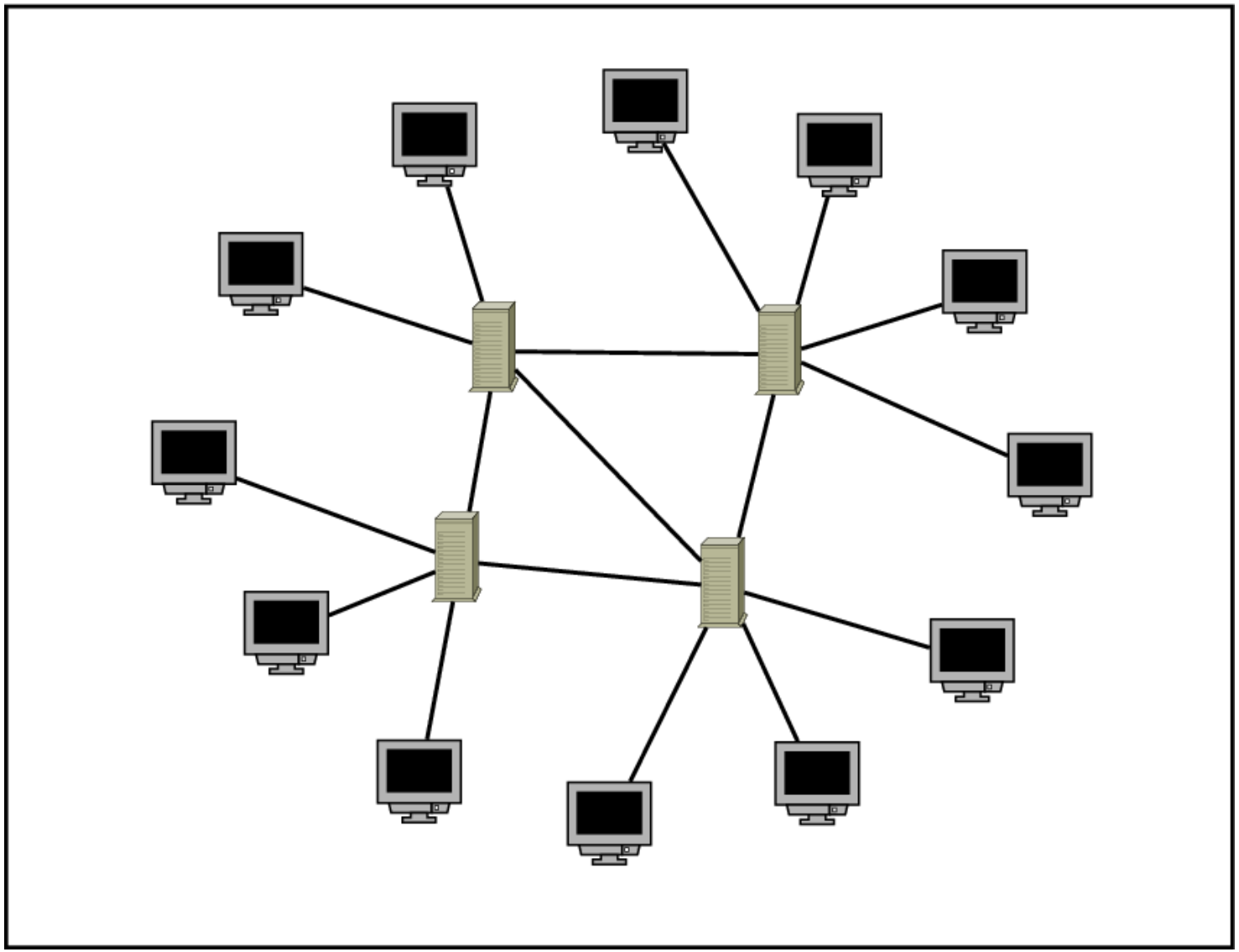

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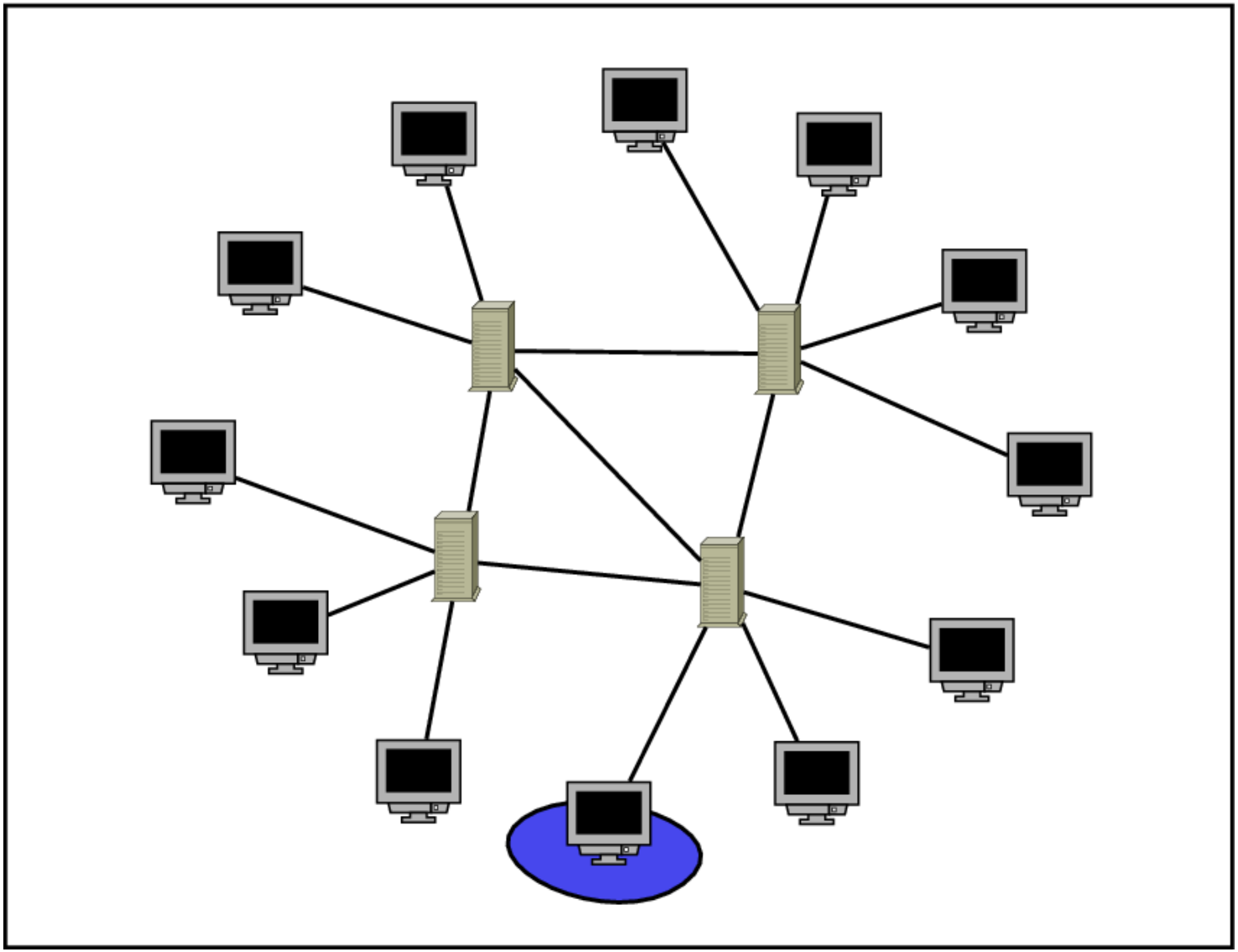

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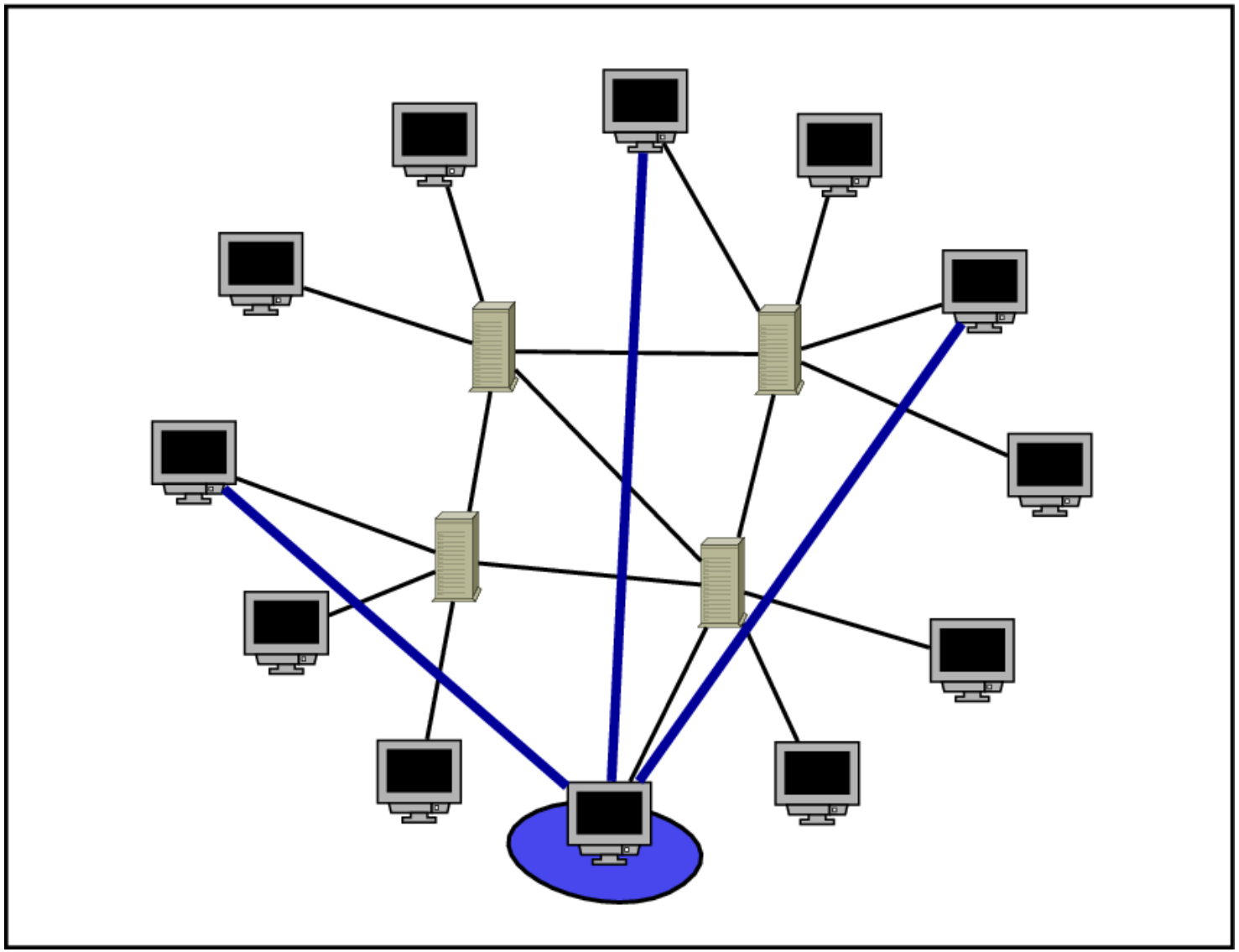

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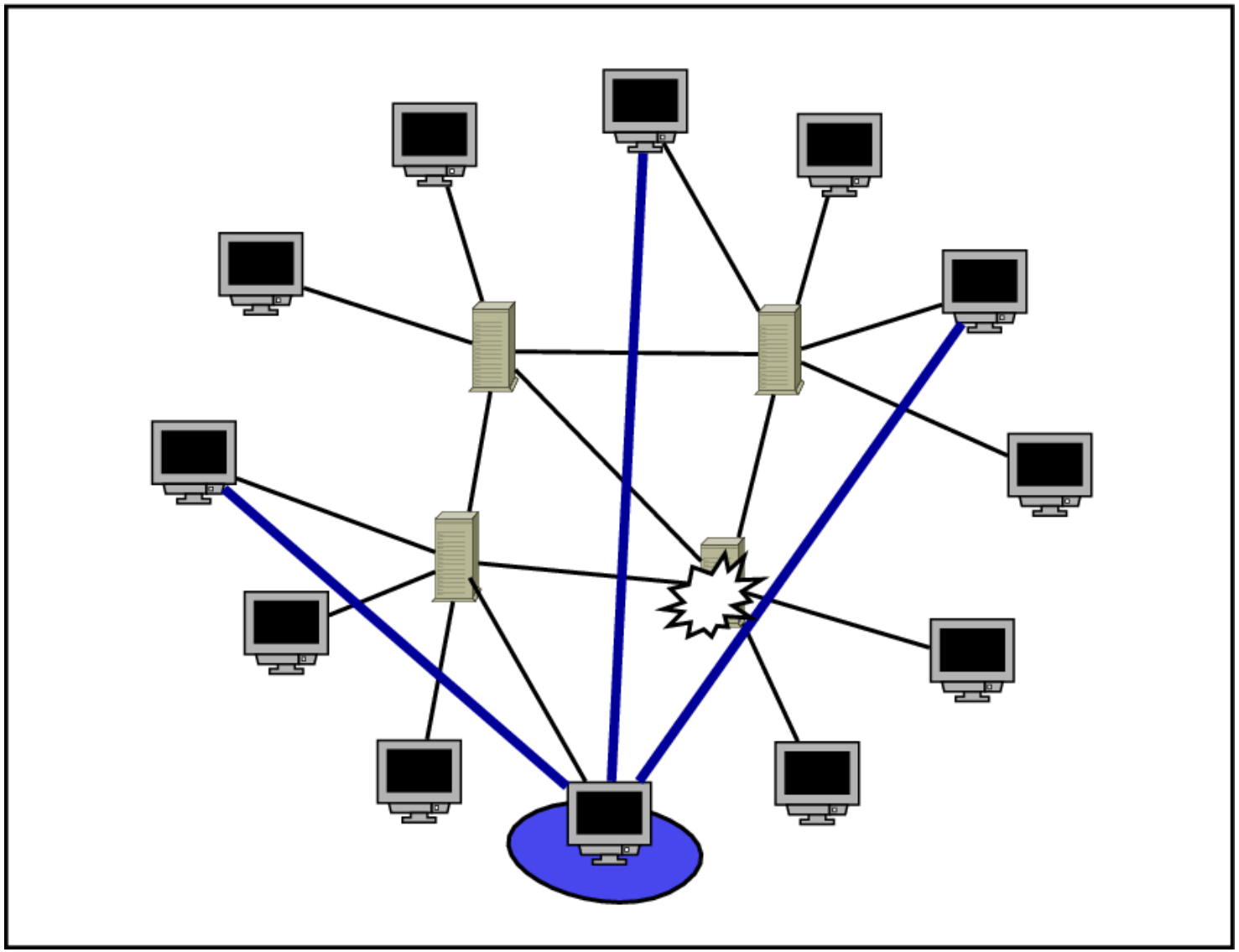

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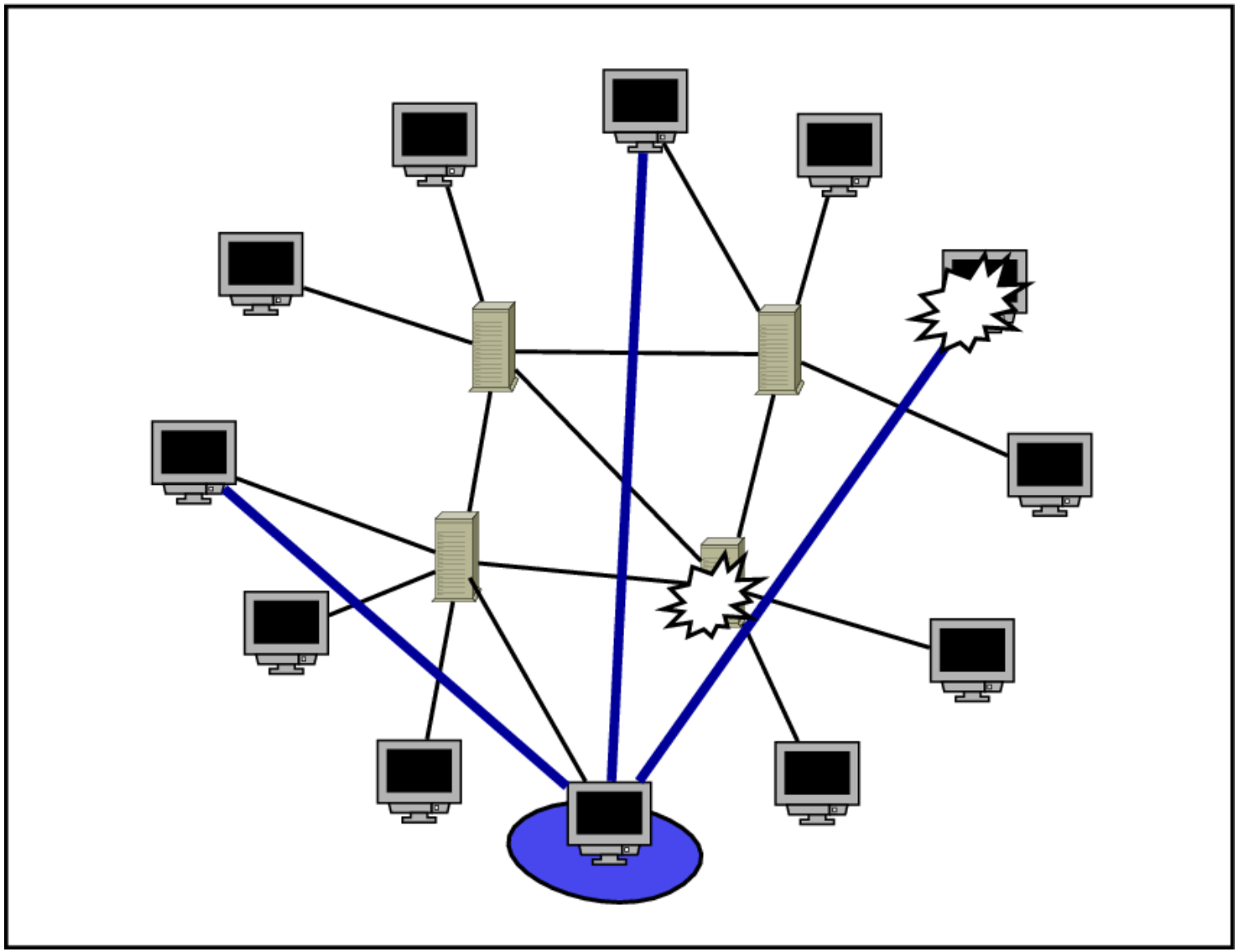

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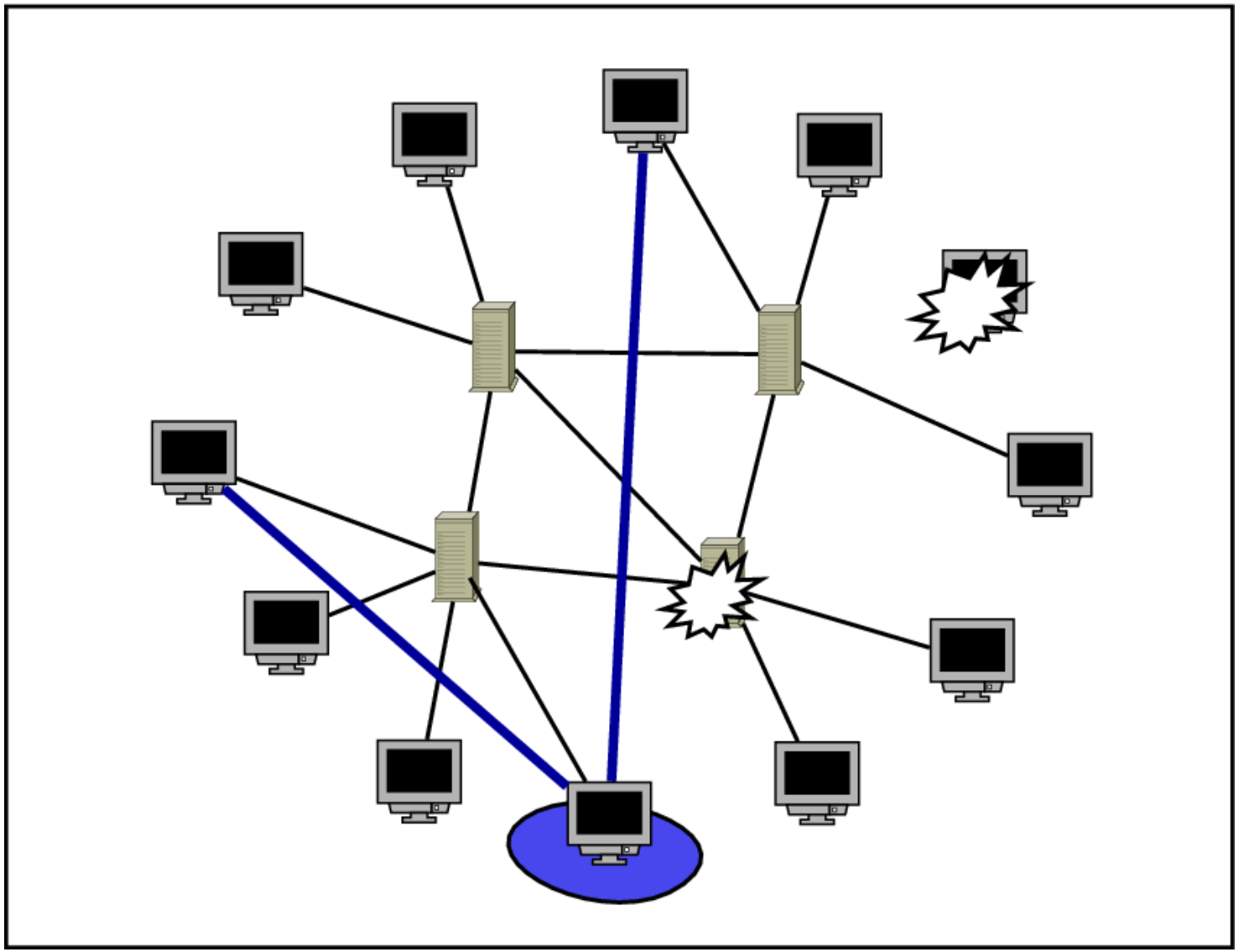

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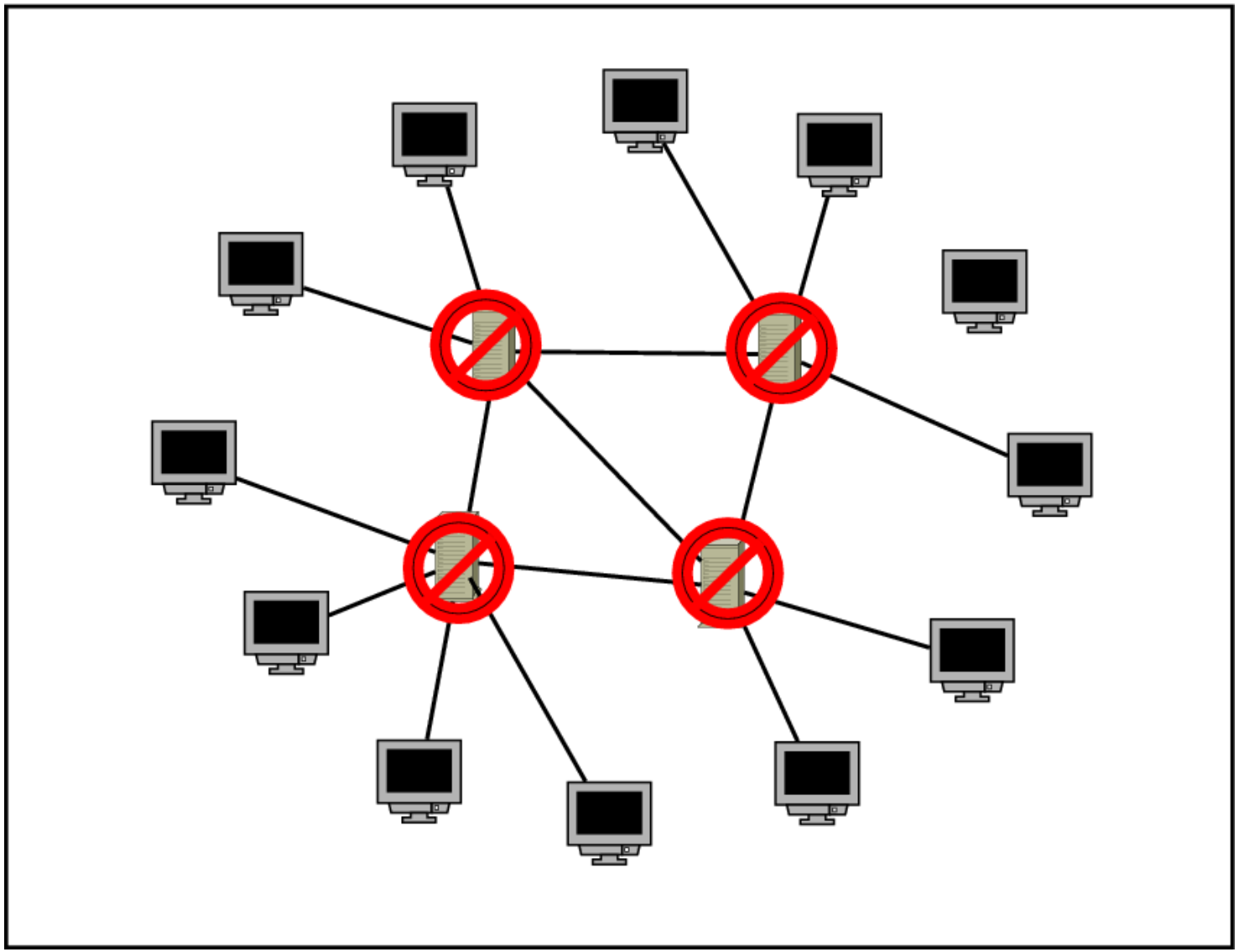

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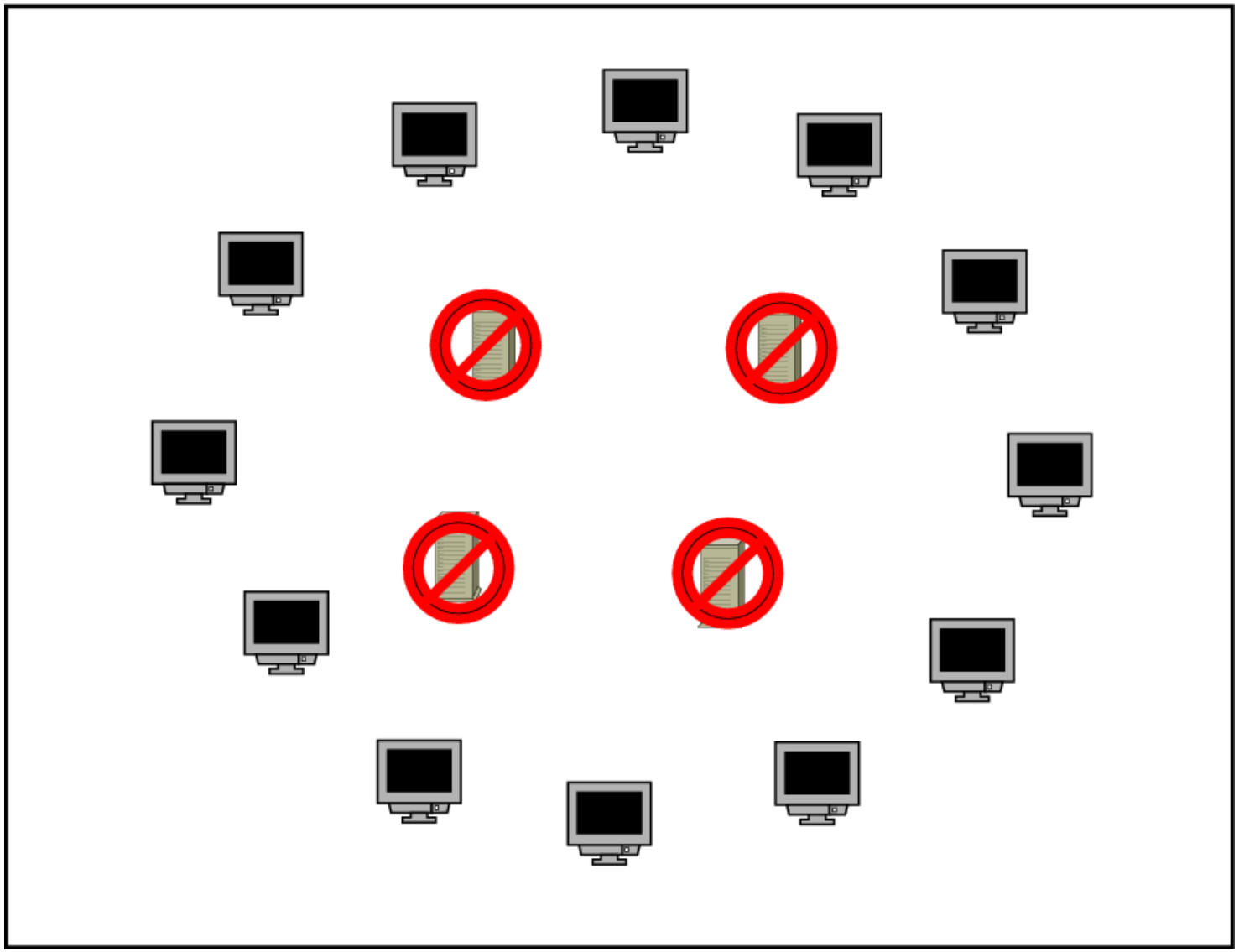

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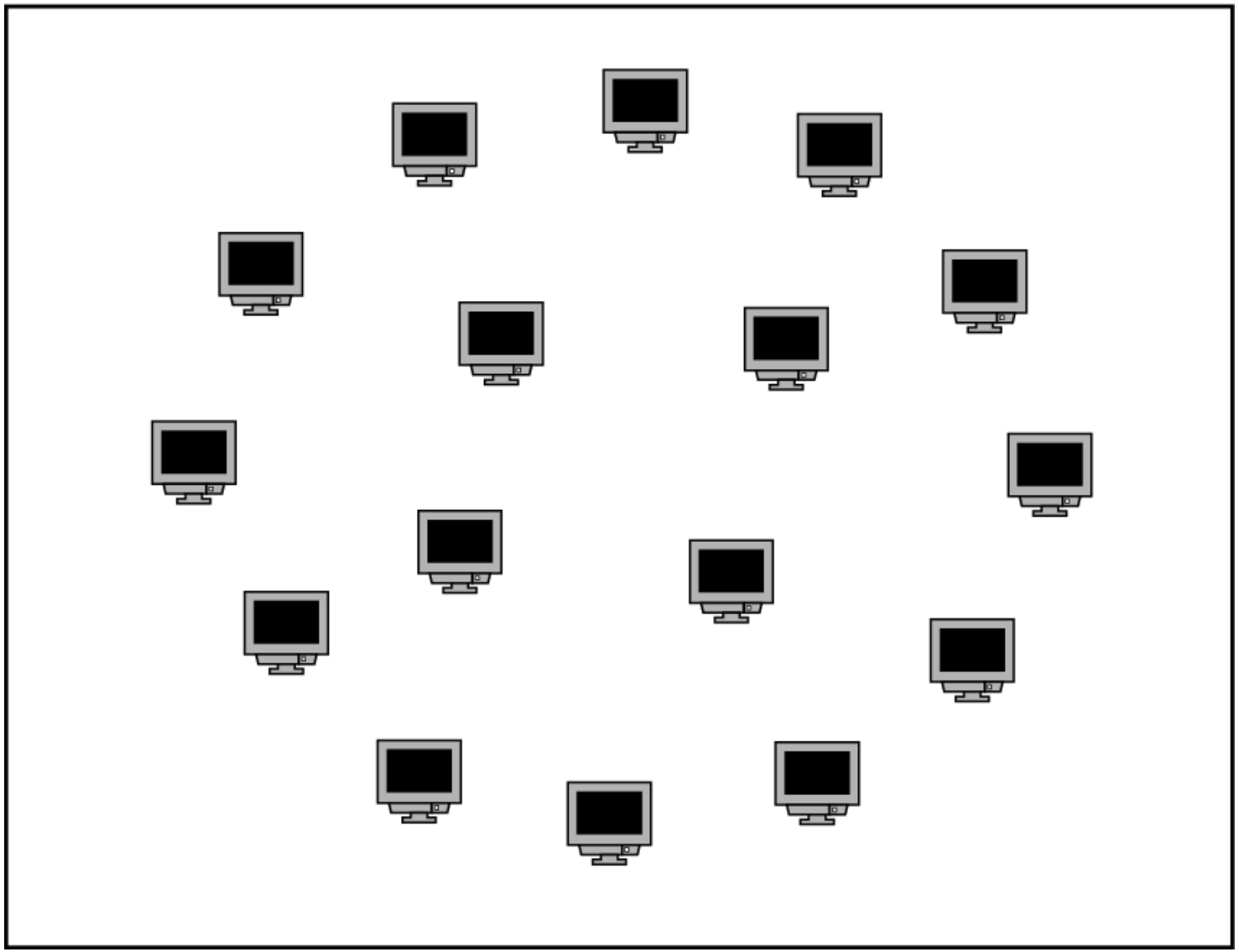

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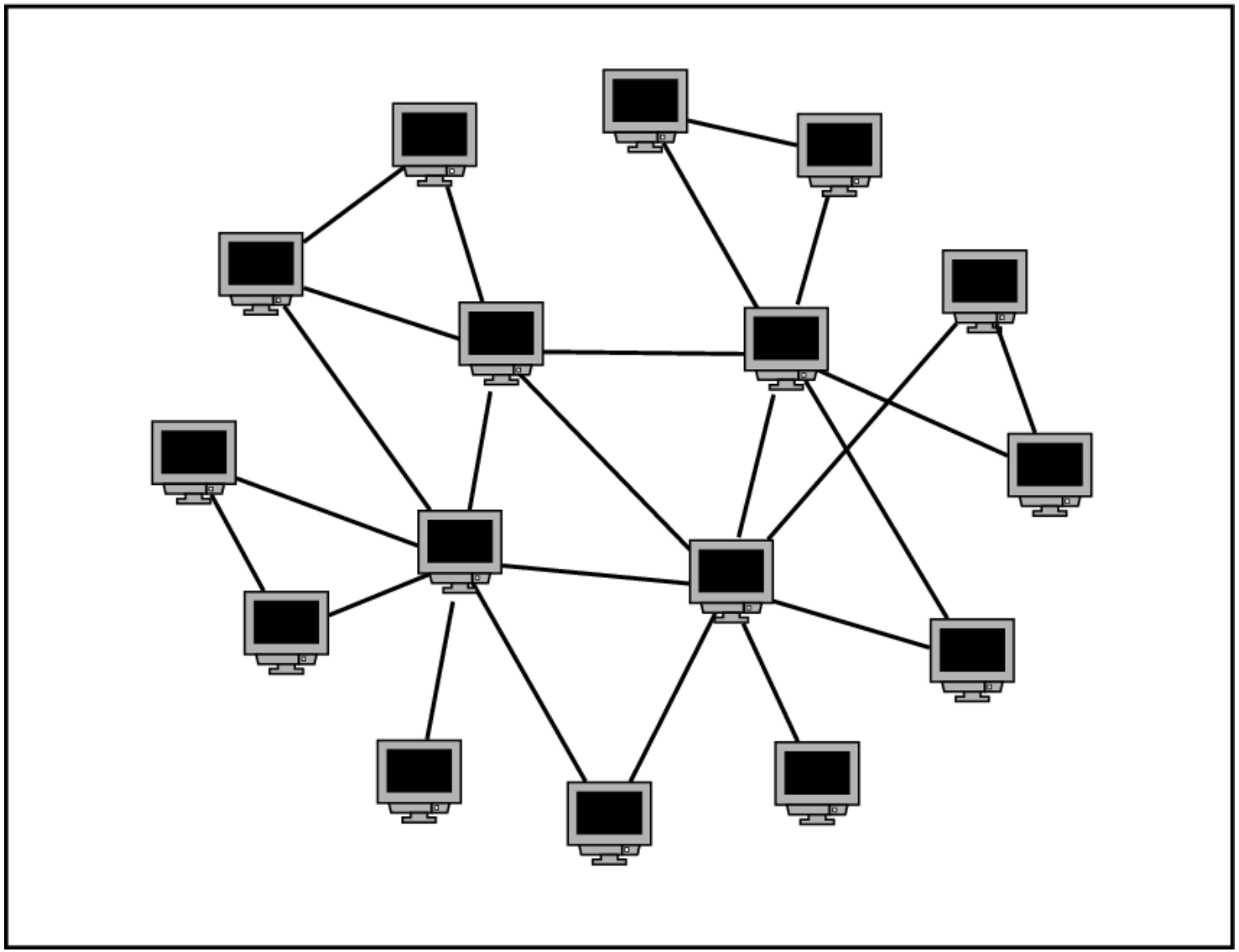

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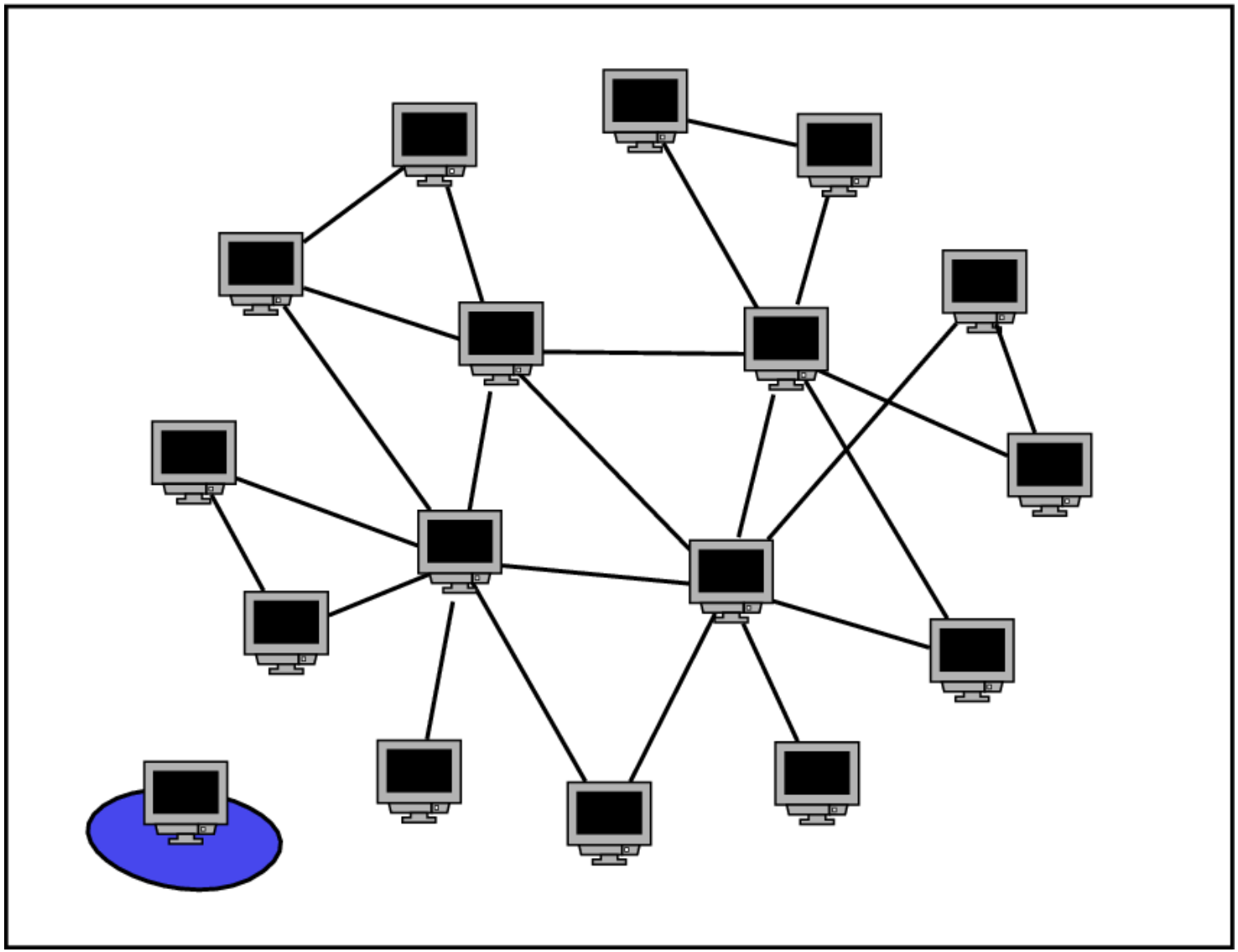

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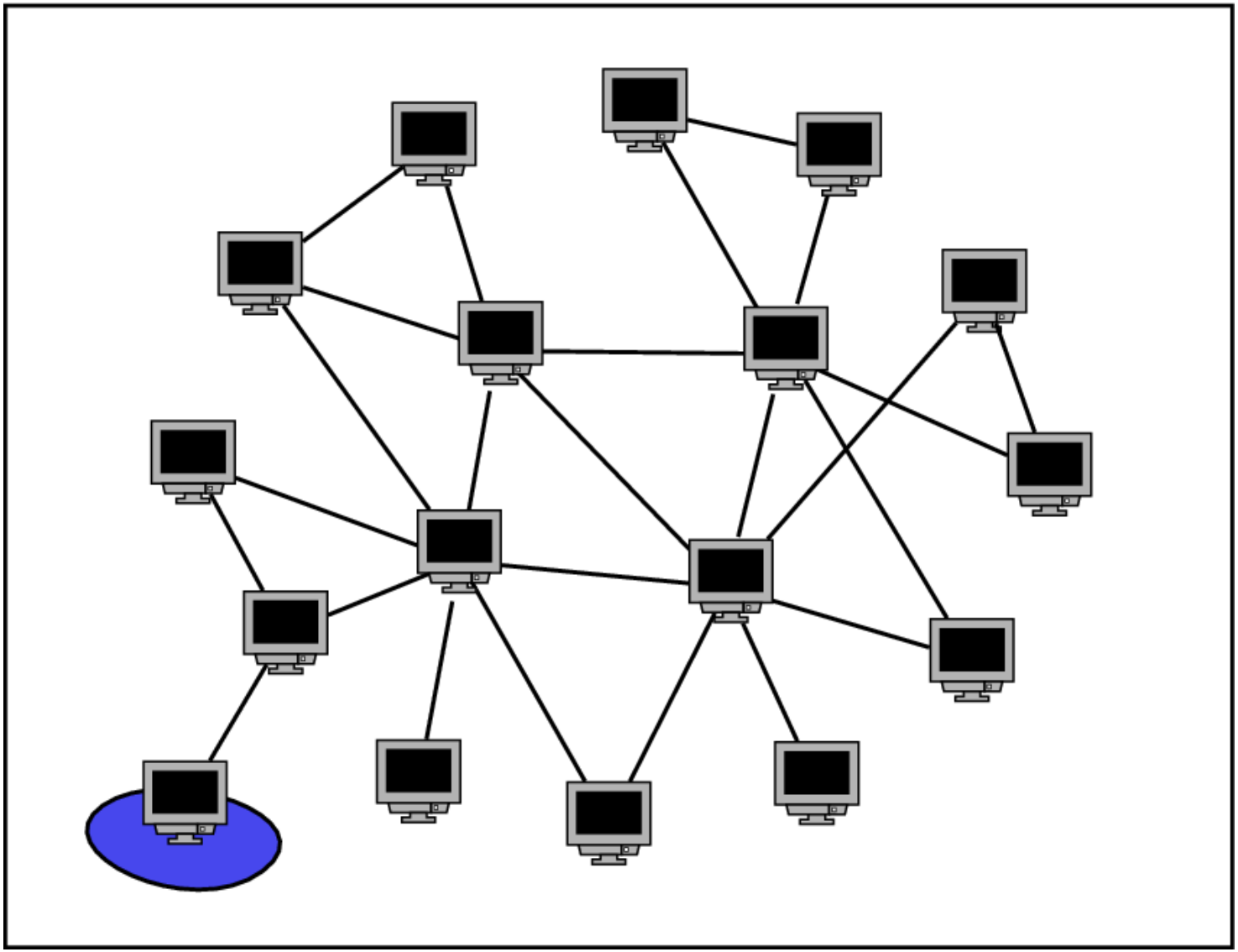

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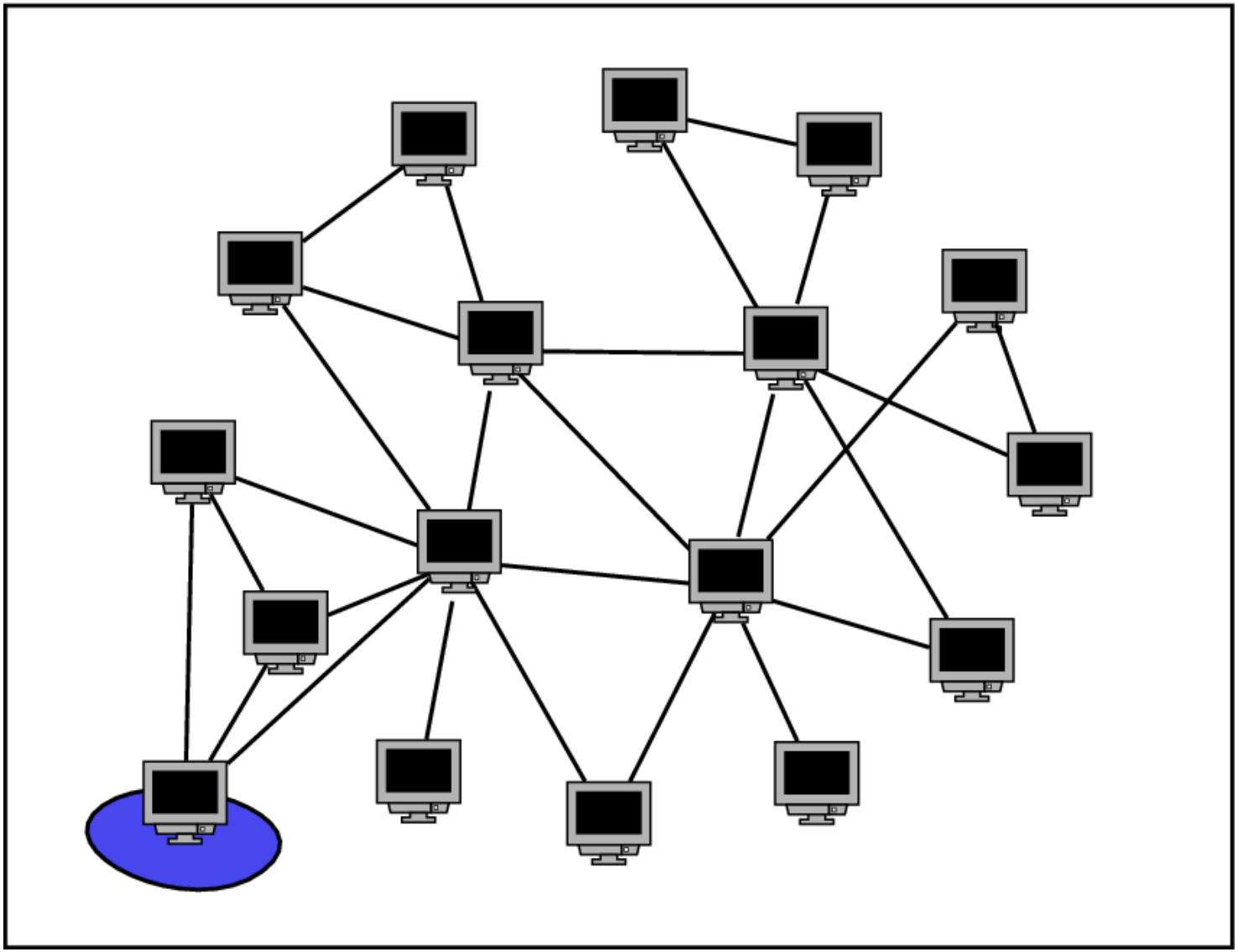

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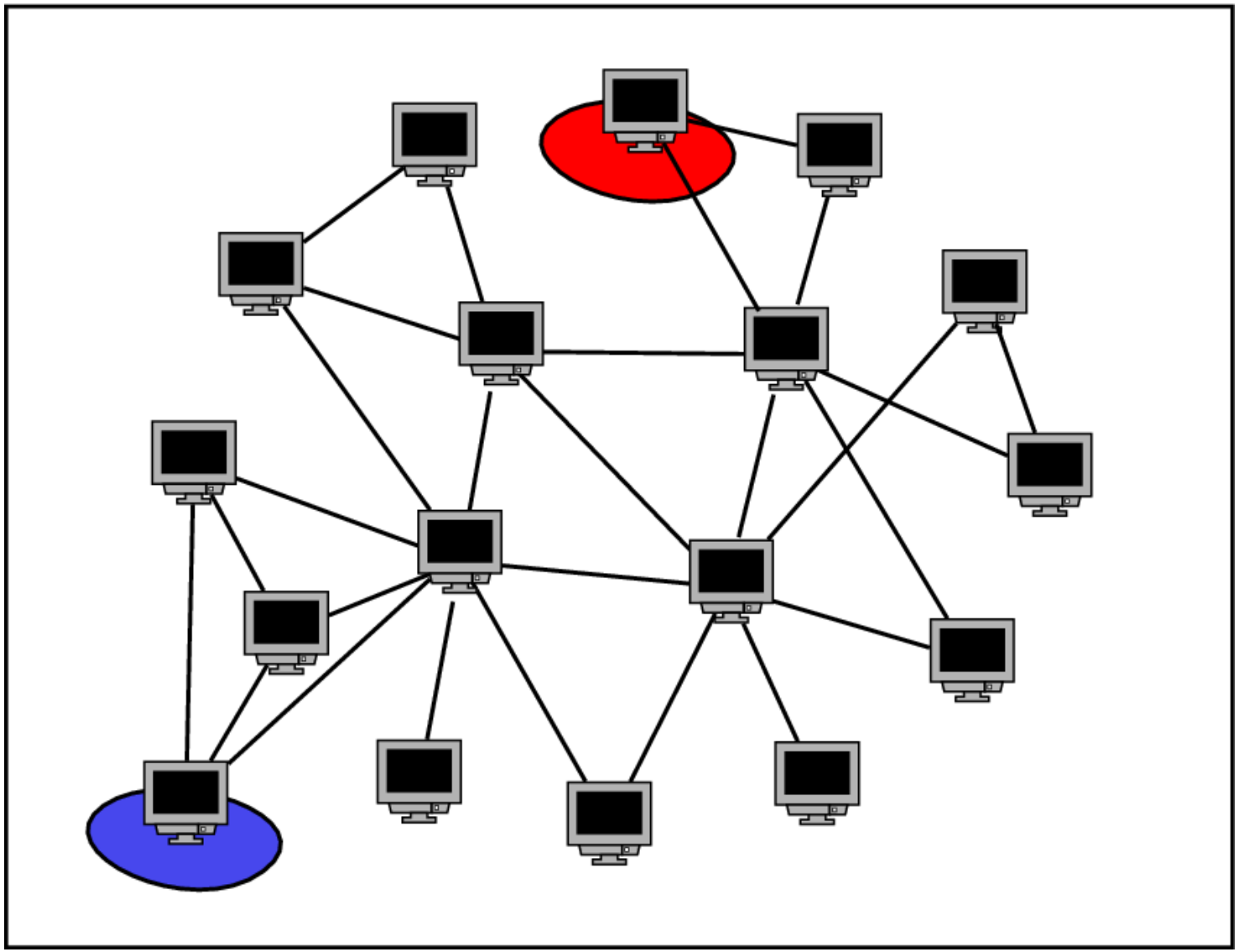

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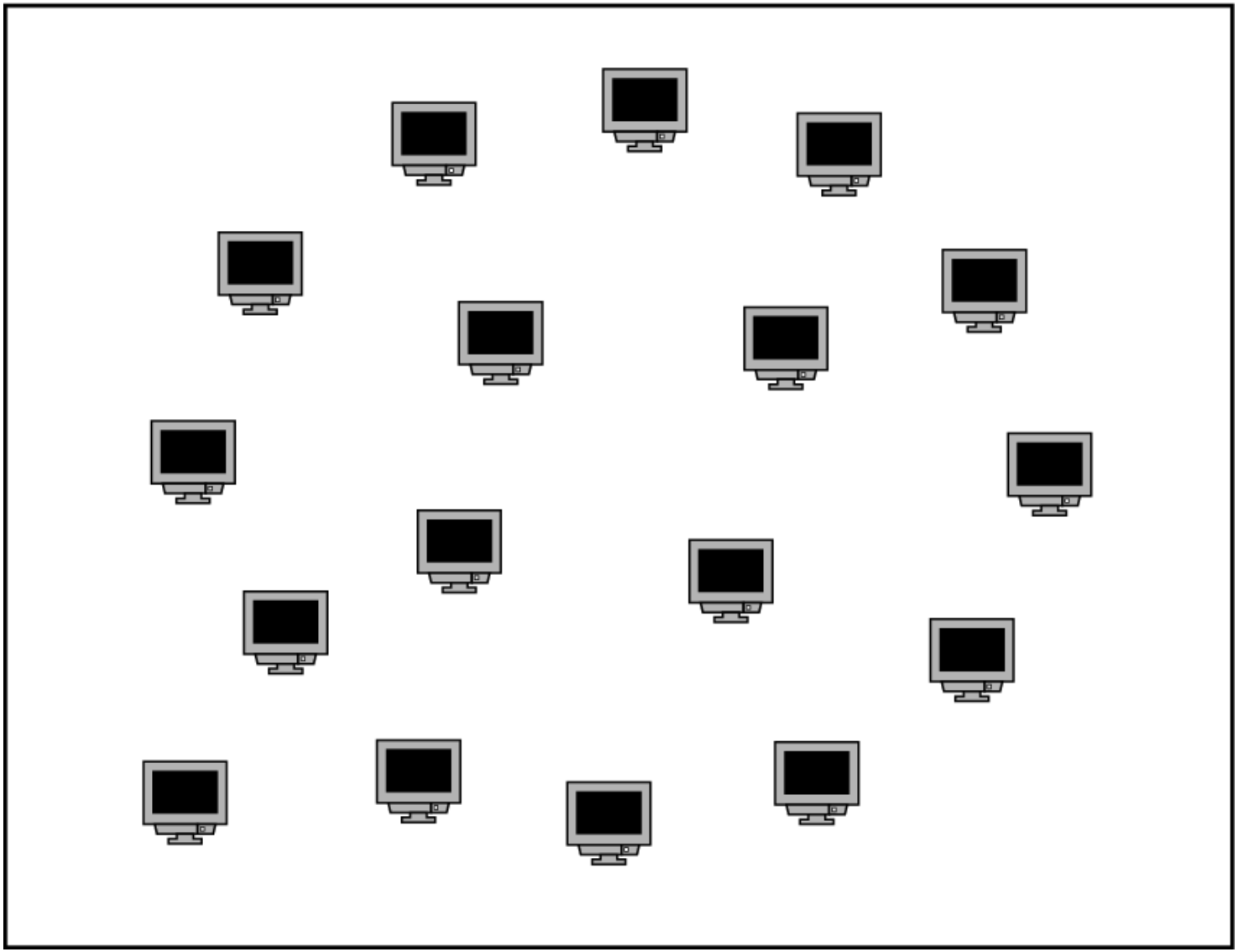

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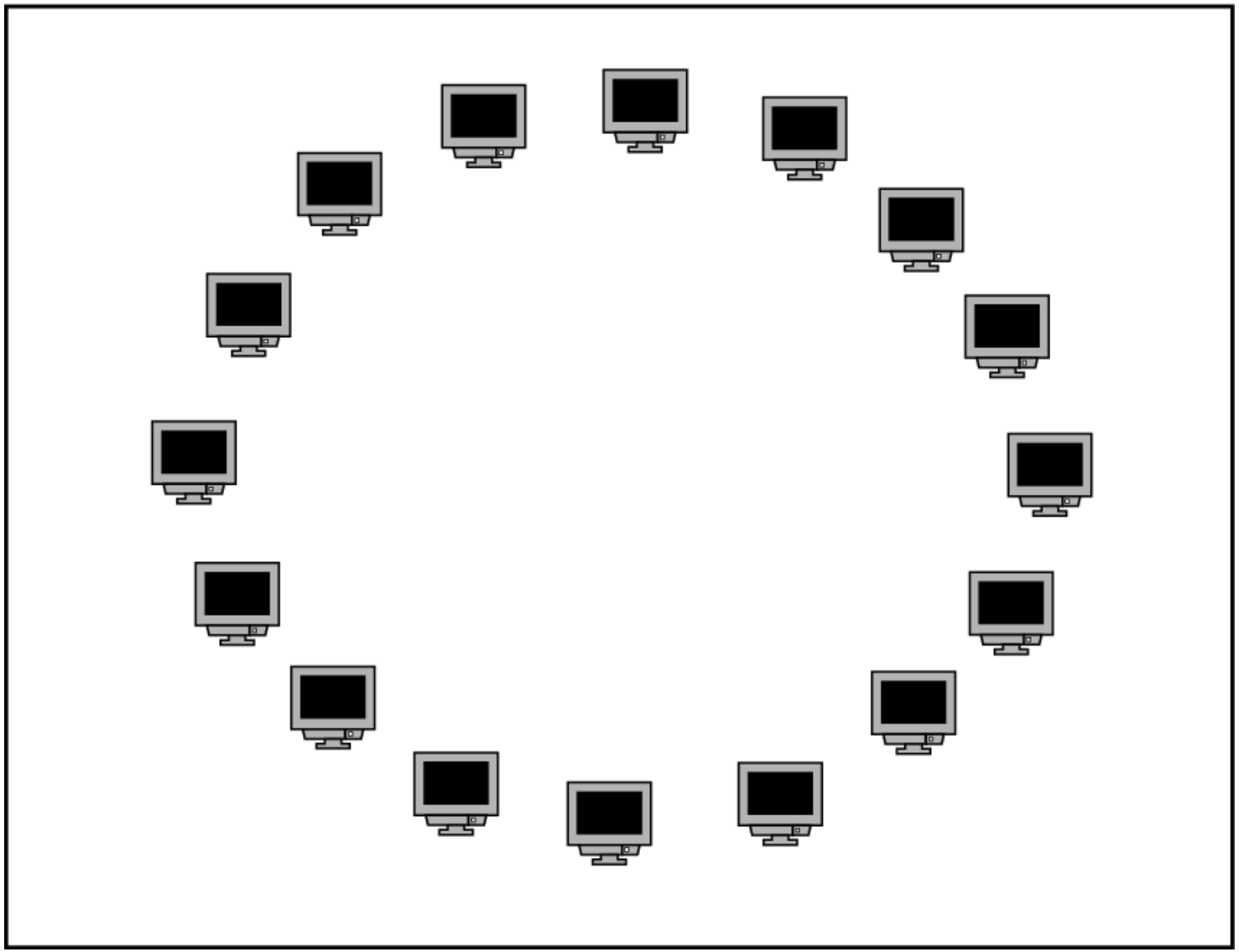

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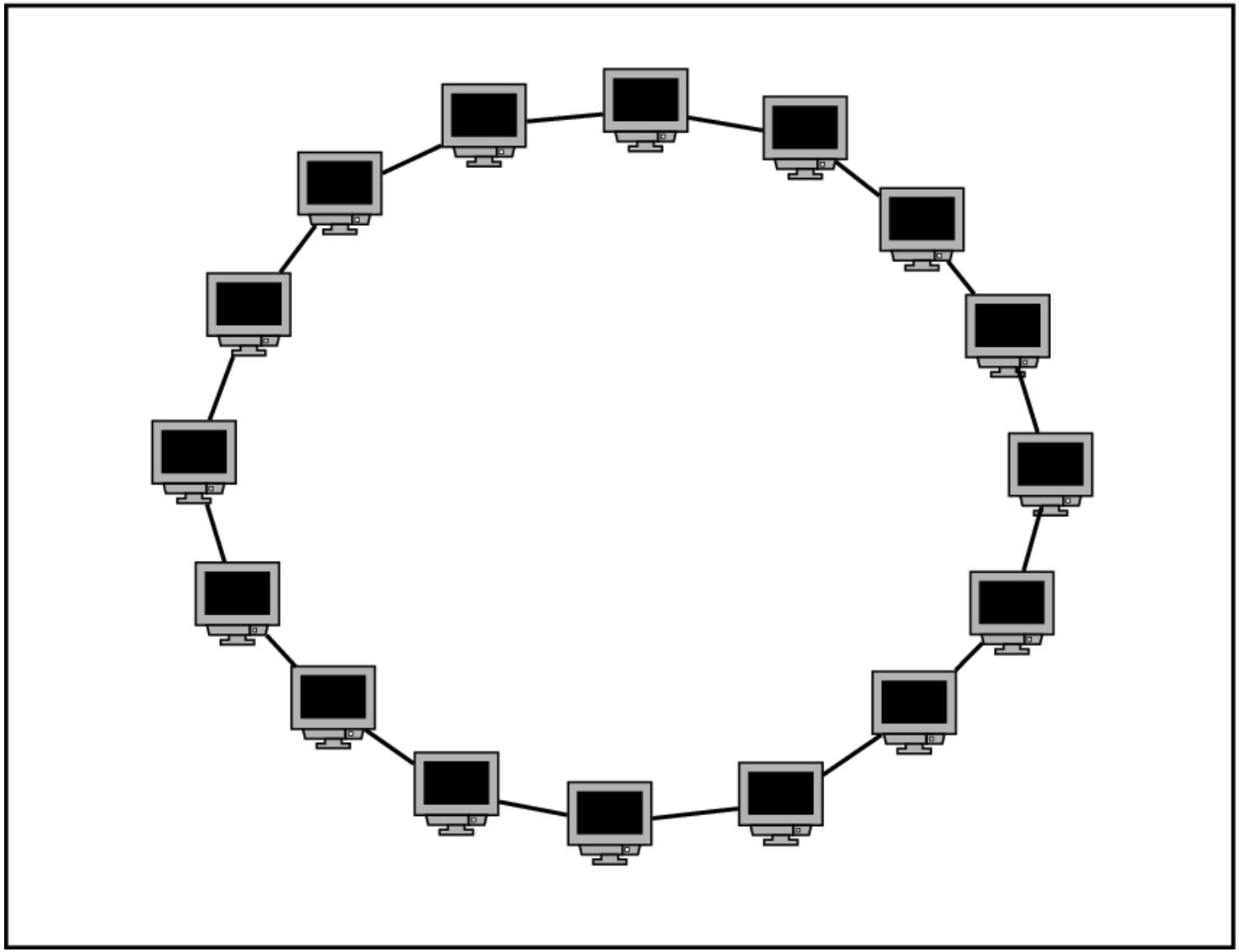
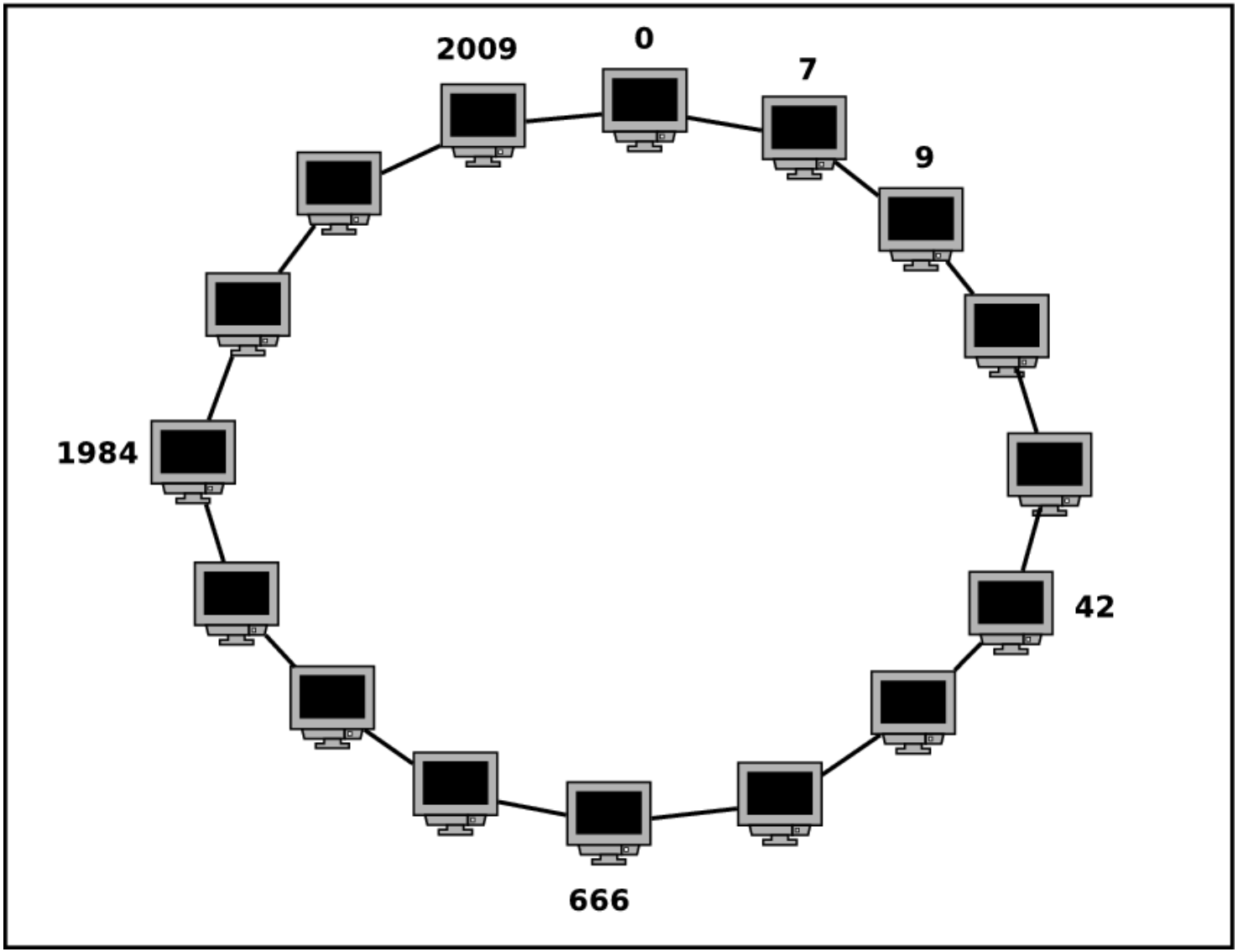


One ring to rule them all



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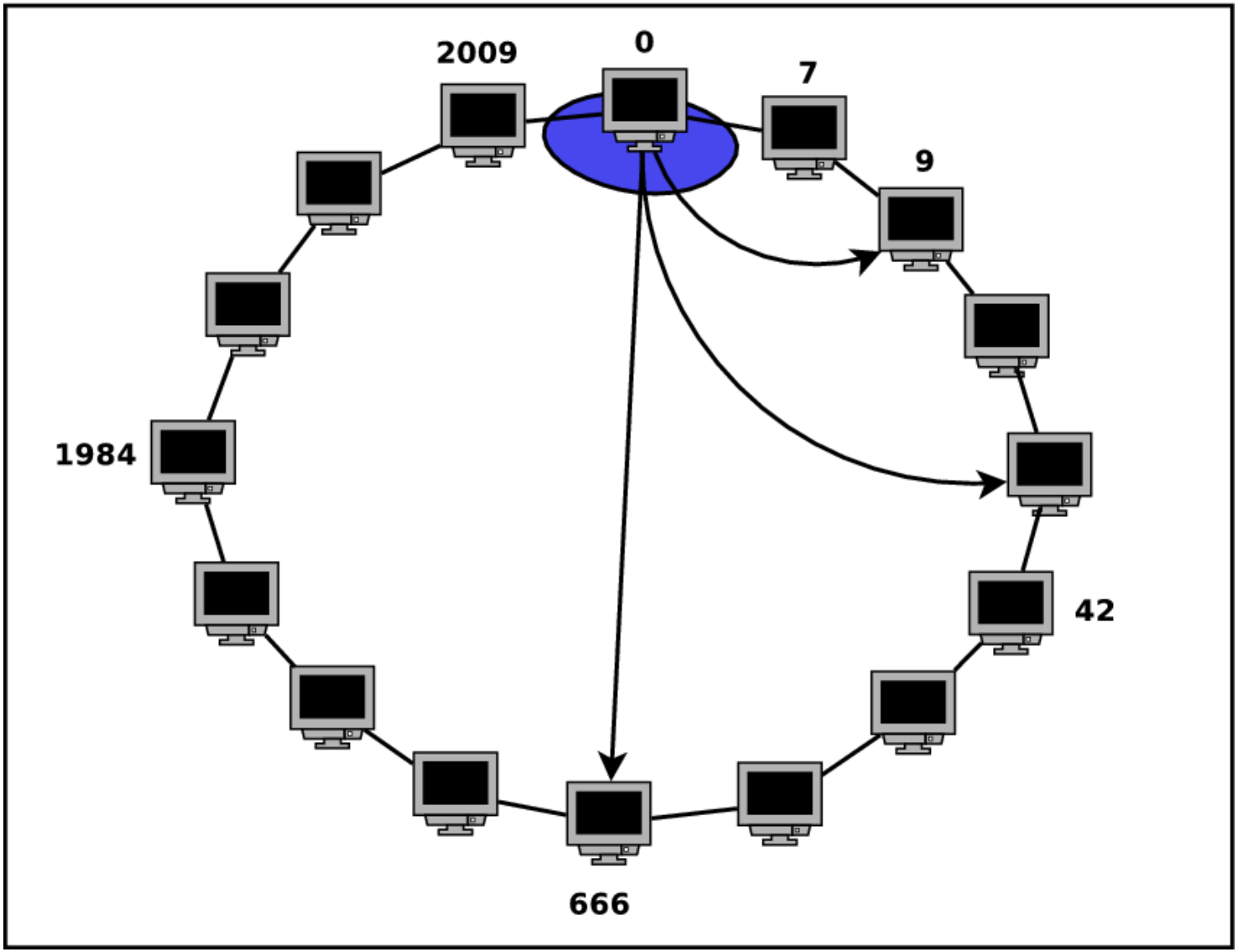

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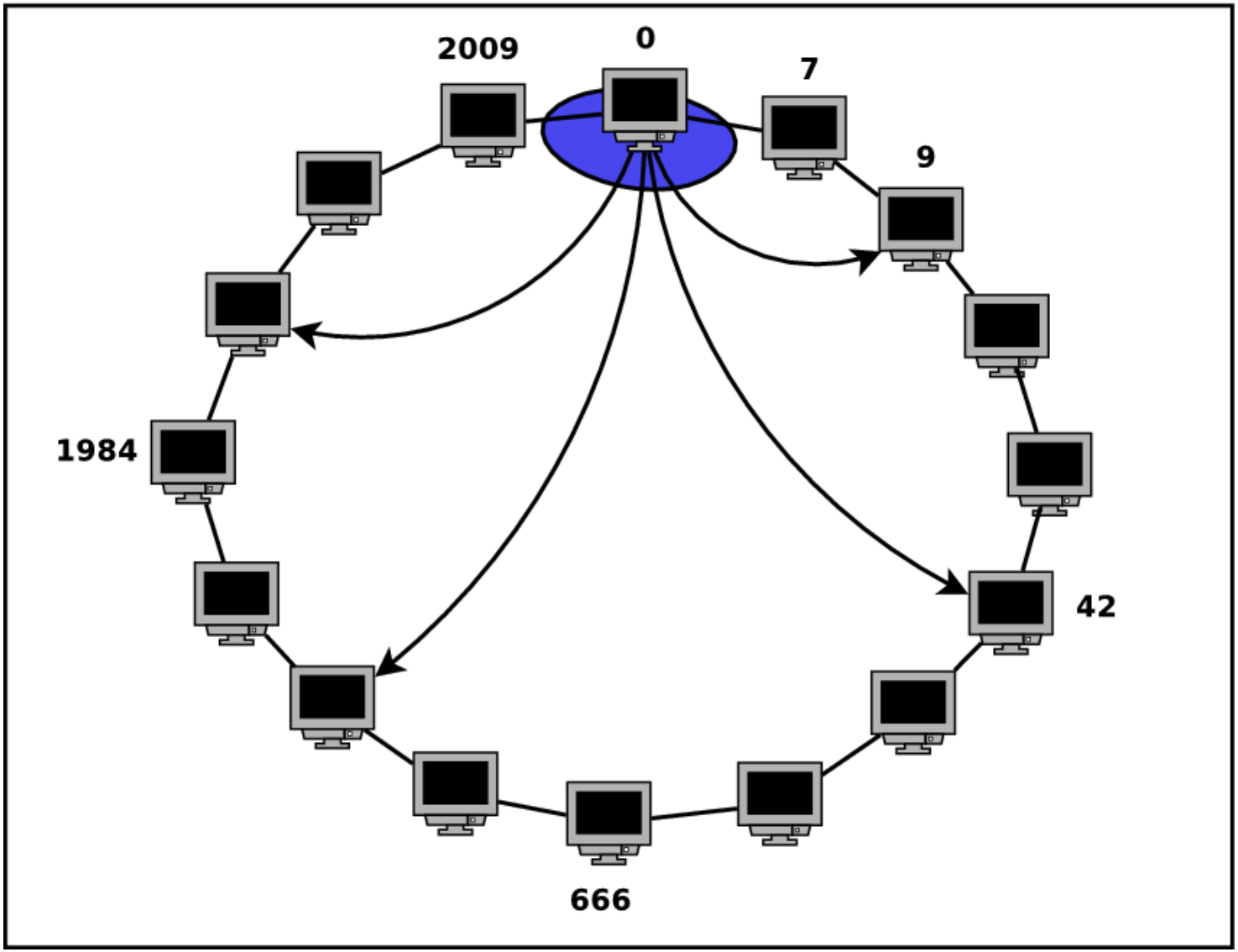

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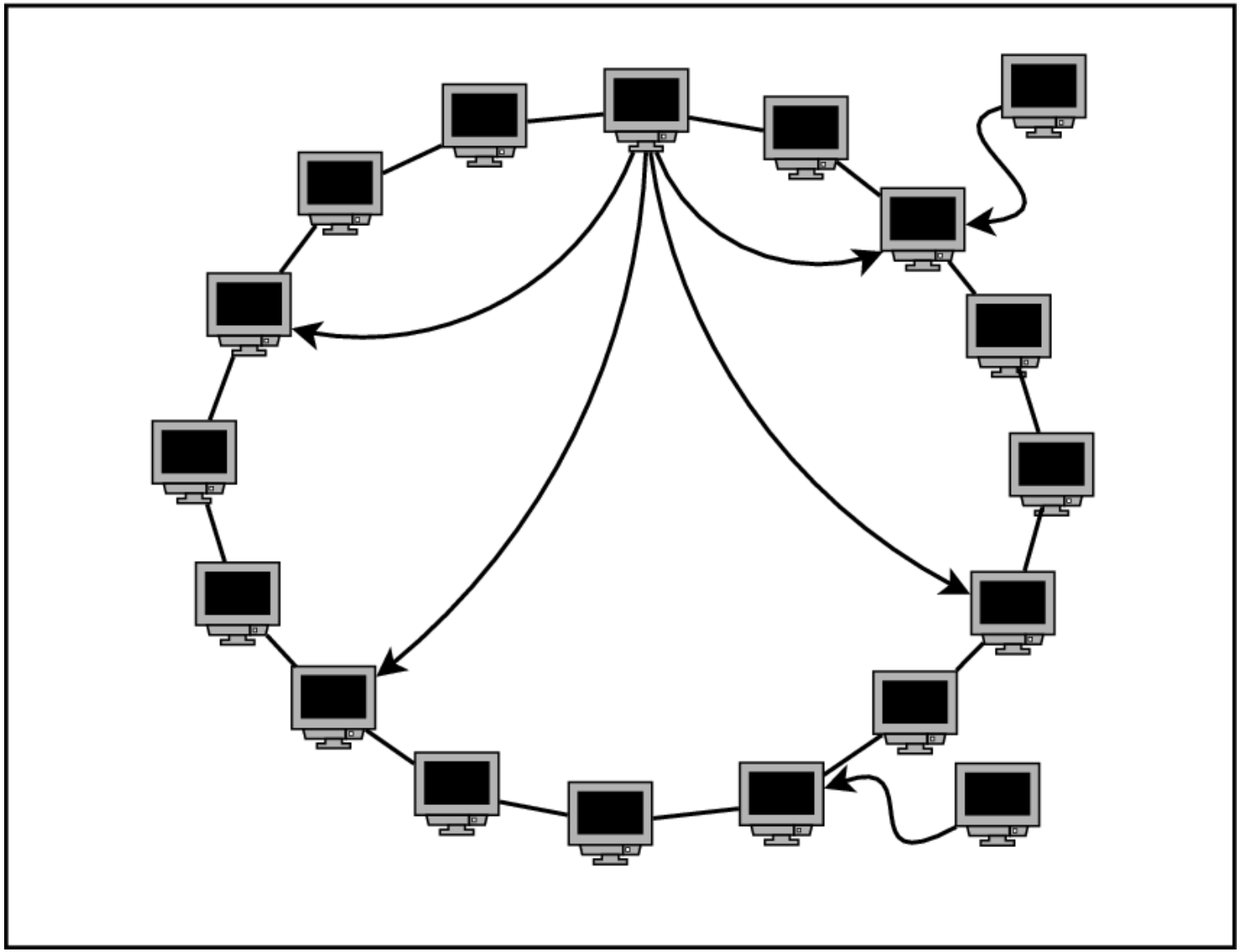

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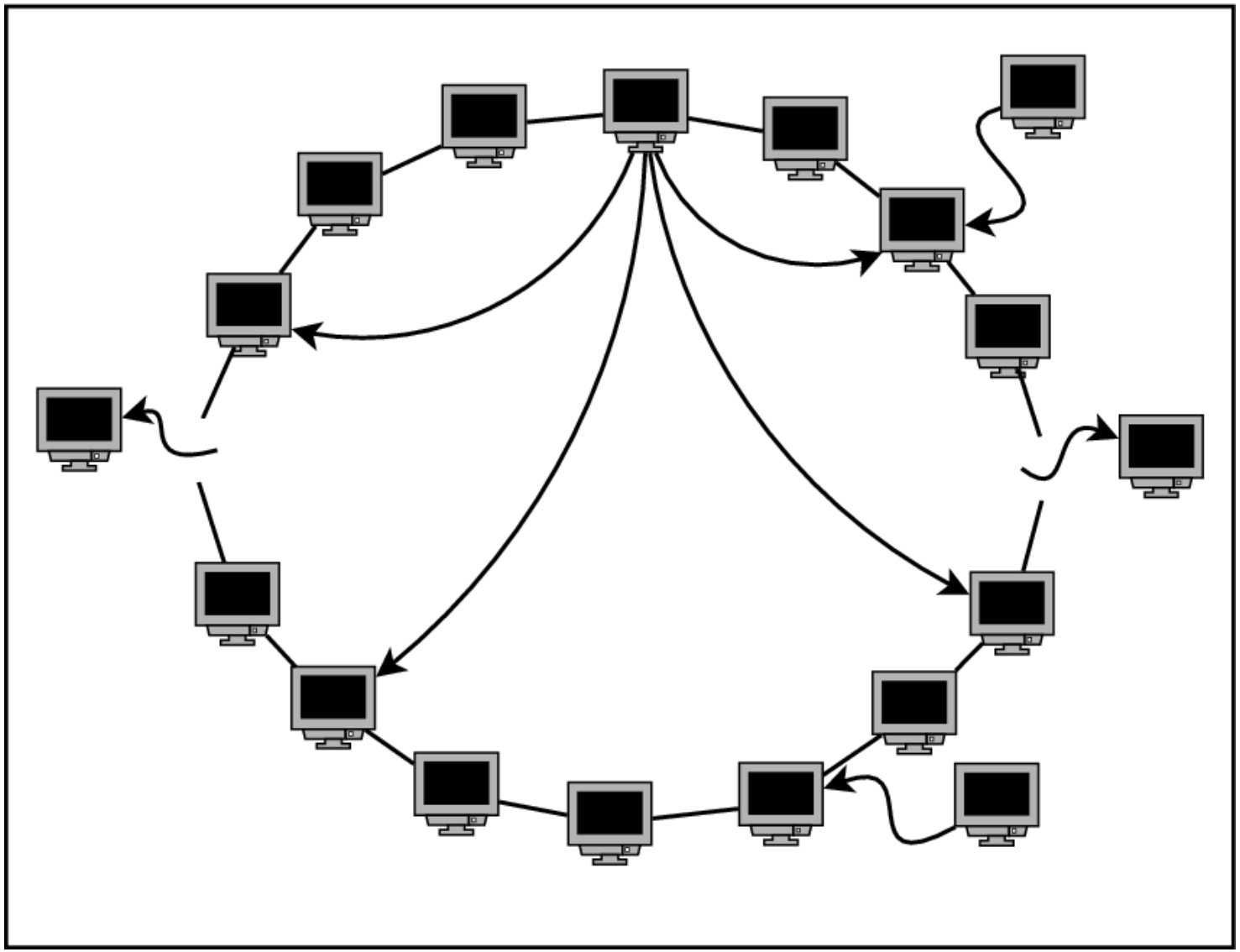

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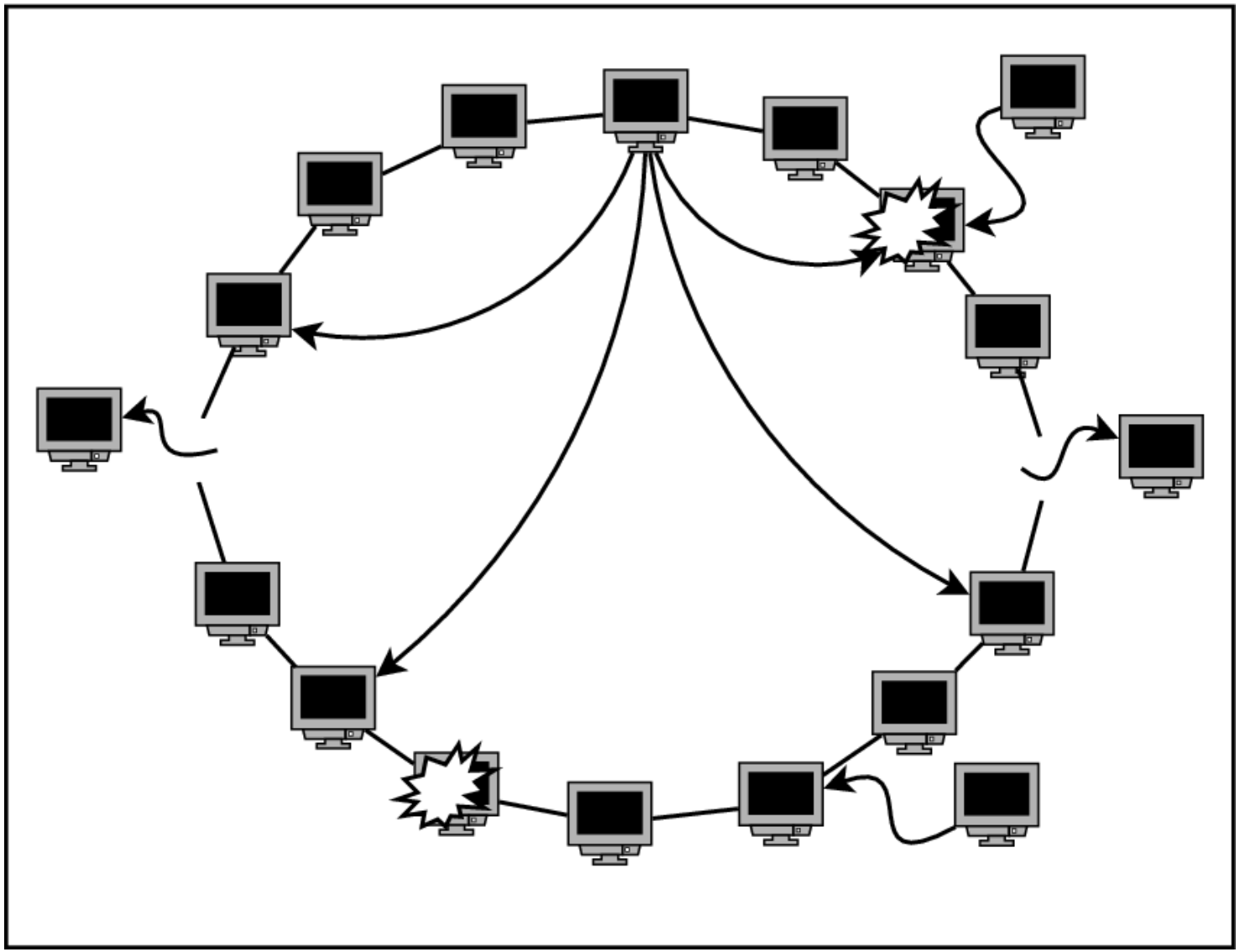

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- Human intervention is lifted to the level of the policies

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- Human intervention is lifted to the level of the policies
- Typical self-management operations include:
  - add/remove nodes
  - tune performance
  - auto-configure
  - replicate data
  - failure detection and recovery
  - intrusion detection and recovery

Chord peer-to-peer network

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The Relaxed-Ring

- joining peer *q* requests a lookup for its key
- *q* sends the *join* message to its successor candidate *r*
- *r* accepts new pred and sends reference *p* to *q*
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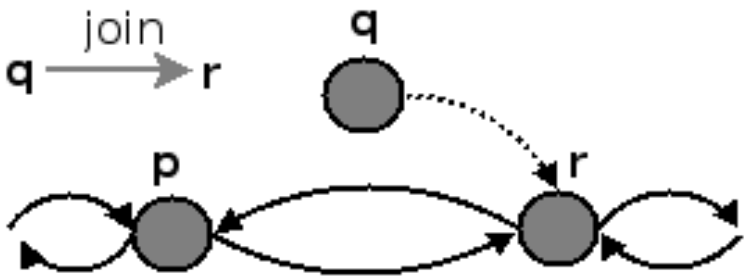

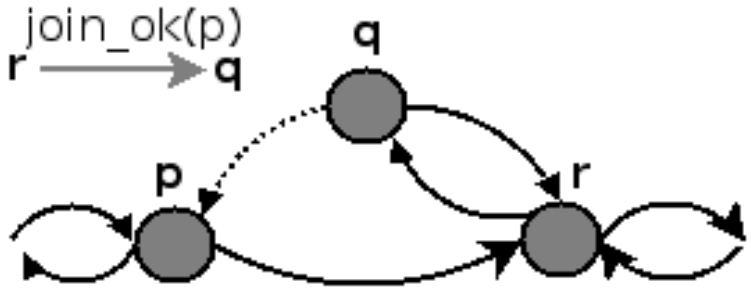

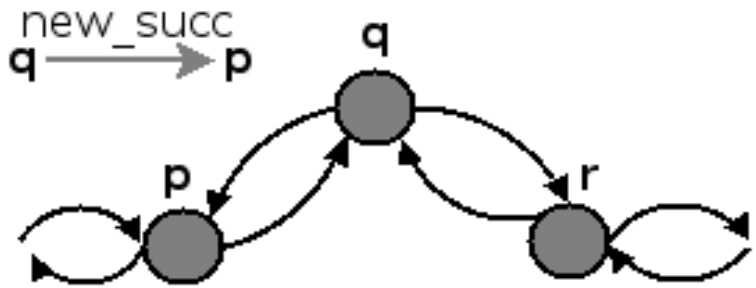

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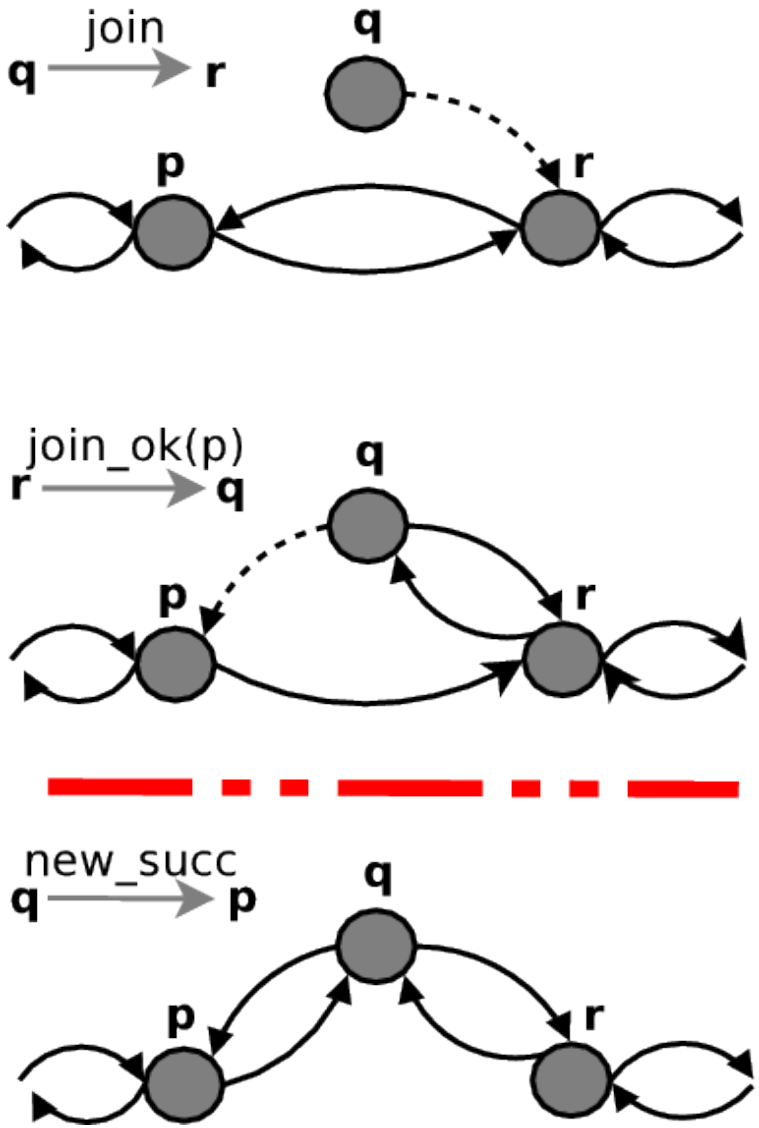

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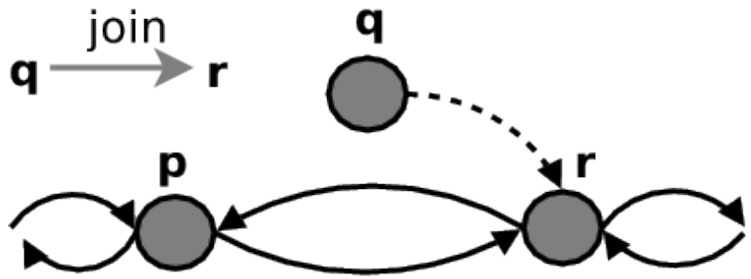
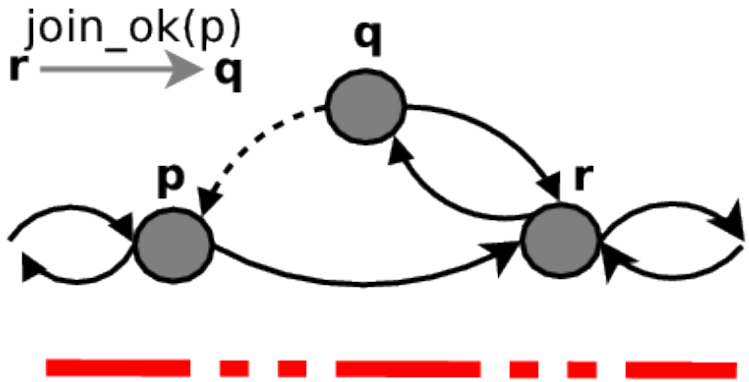
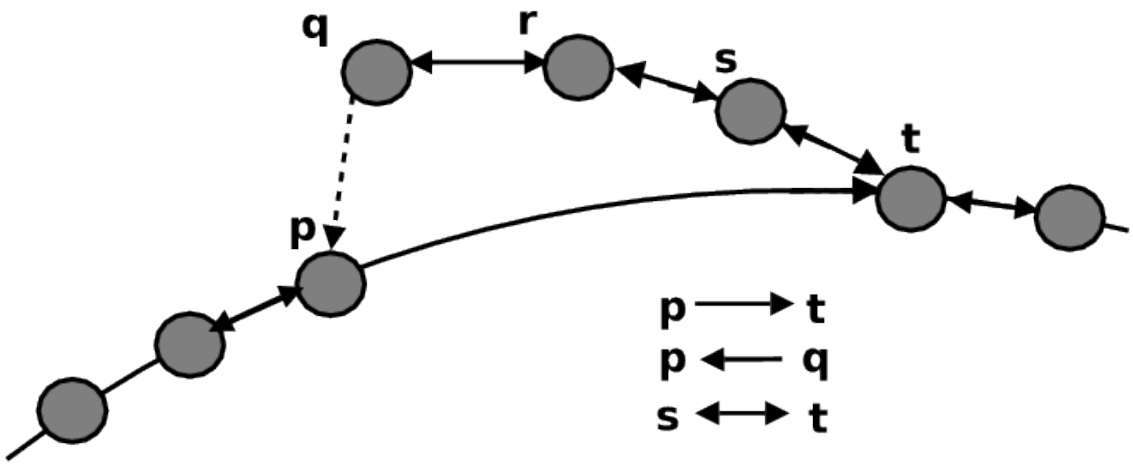
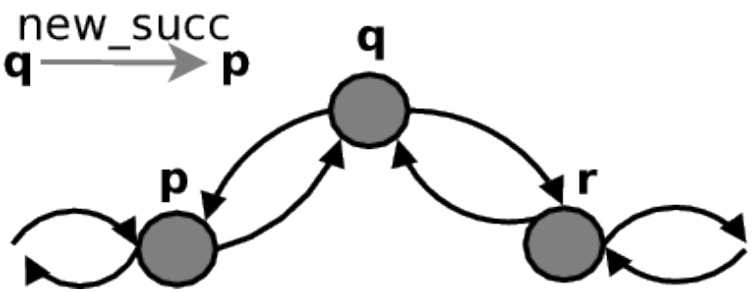
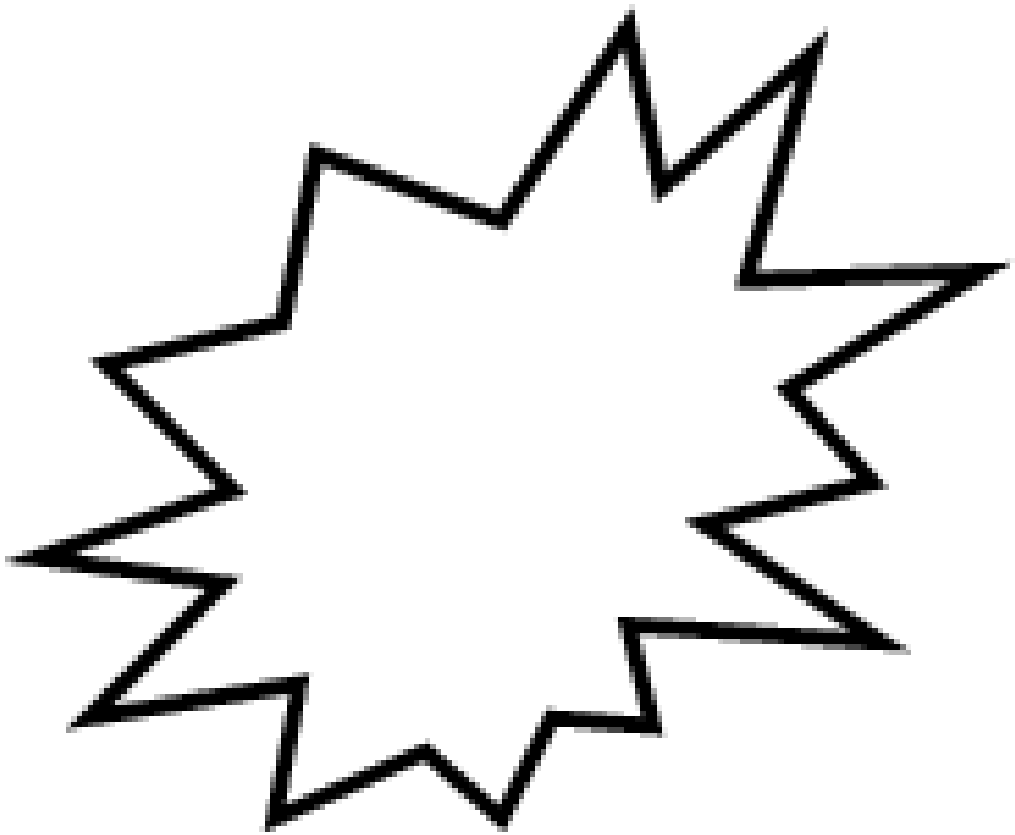








Failures



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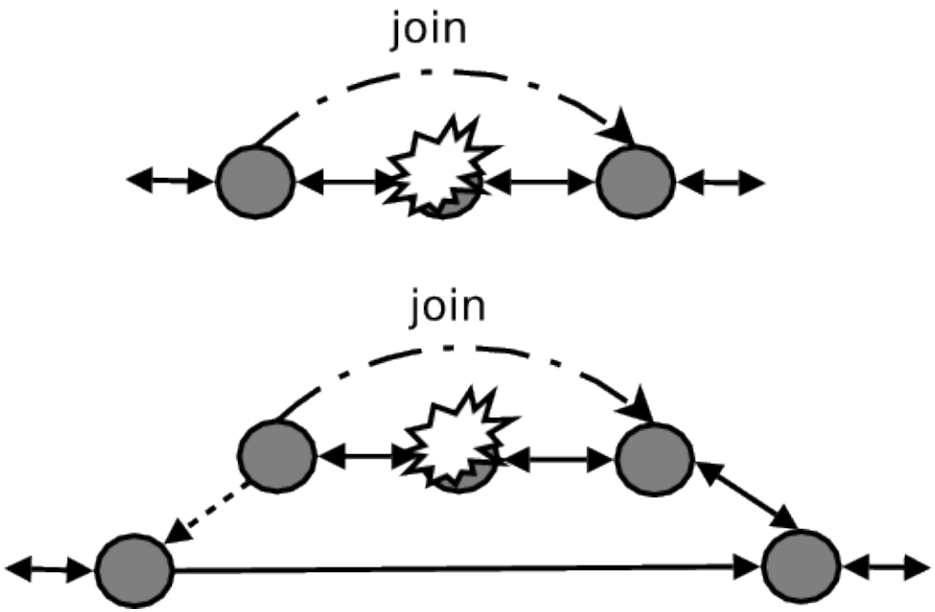
- When a peer detects that its successor has crashed, it contacts the first peer in its successor list for recovery



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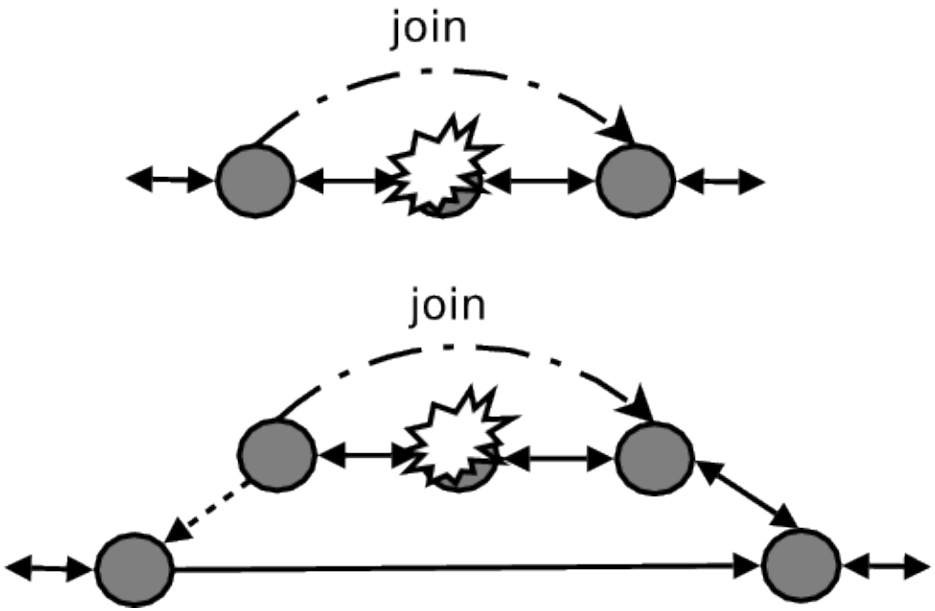

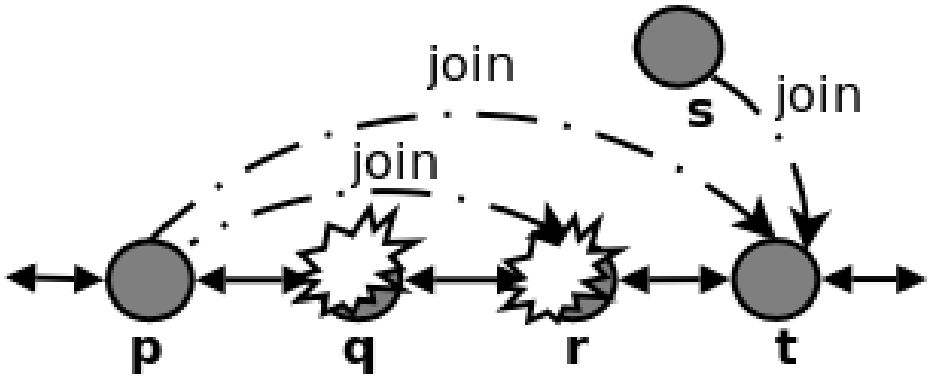

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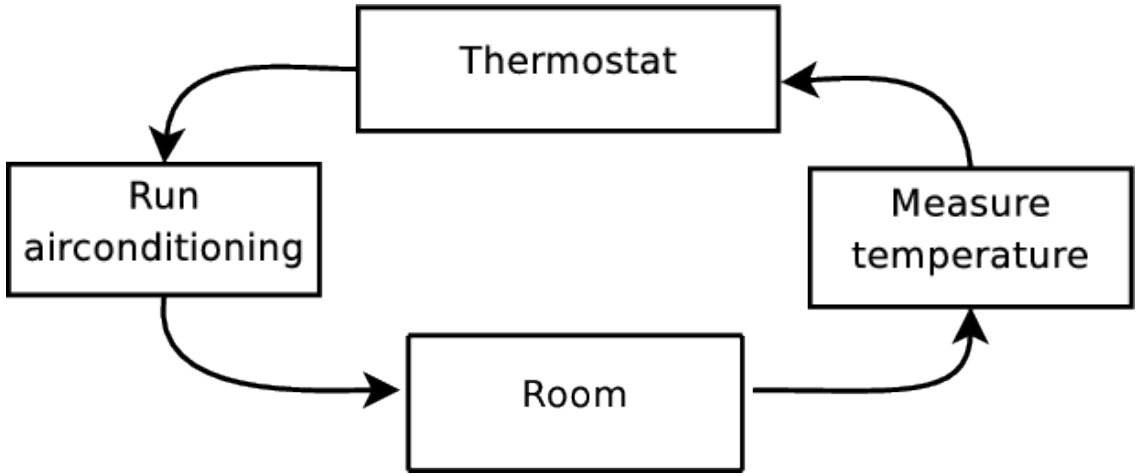
- PALTA self-adapting from fully connected to relaxed-ring
- It handles peers with limited connectivity

Feedback Loop



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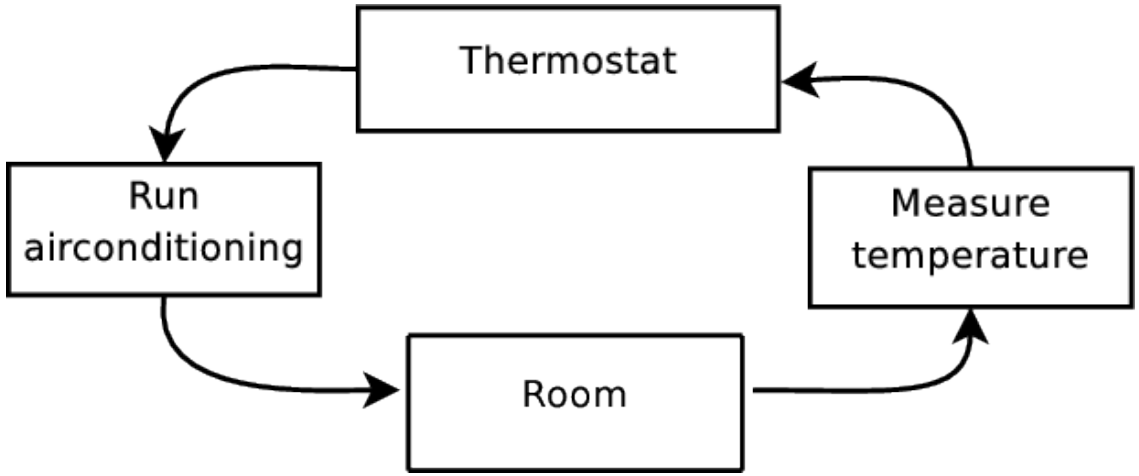
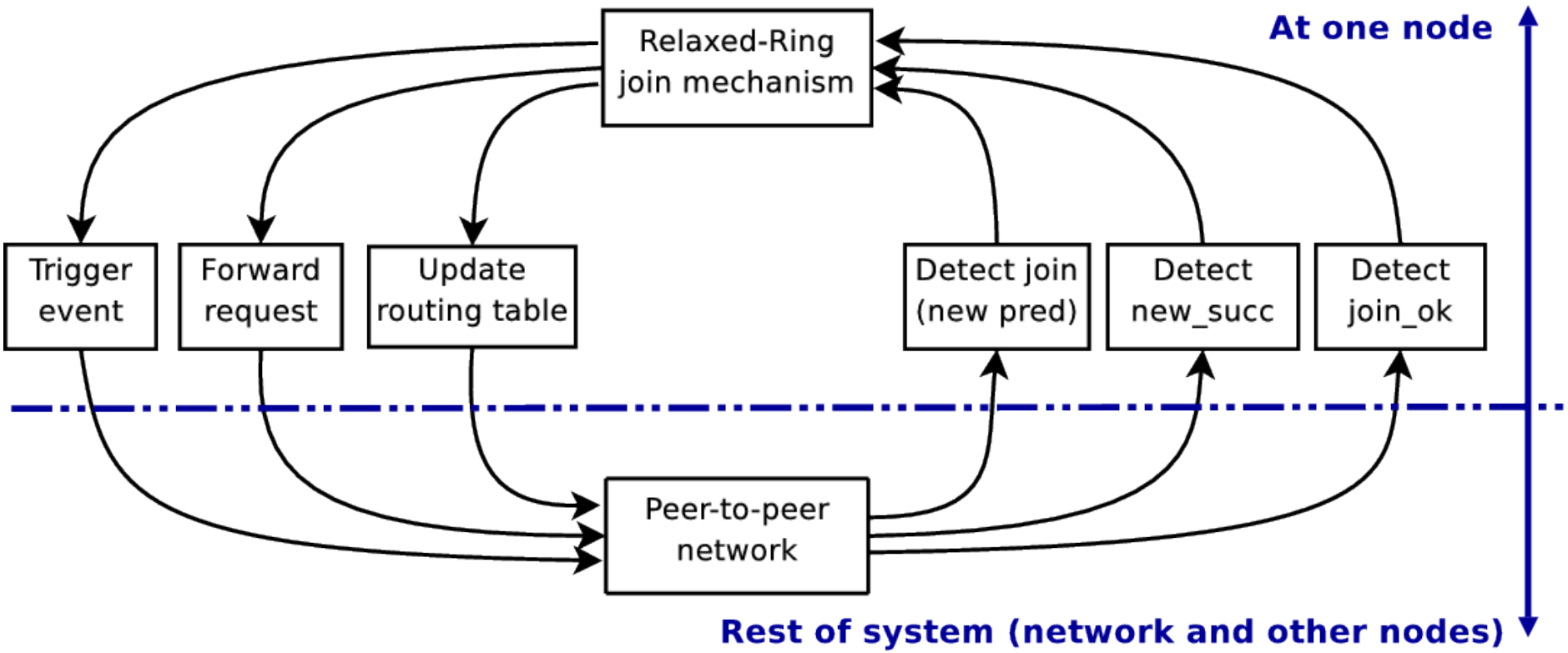


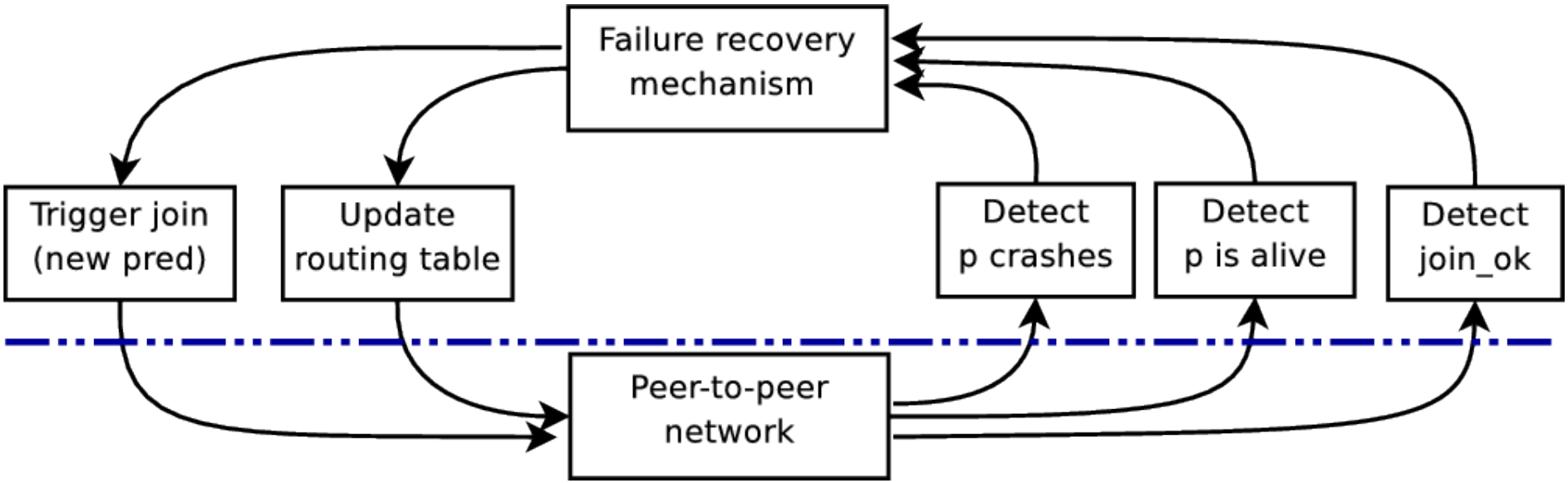
- Sub-system is constantly monitored
- One or more components in charge of calculating correction
- Actuators perform corrective actions
- Convergence to a stable global state

Join Algorithm as a Feedback Loop



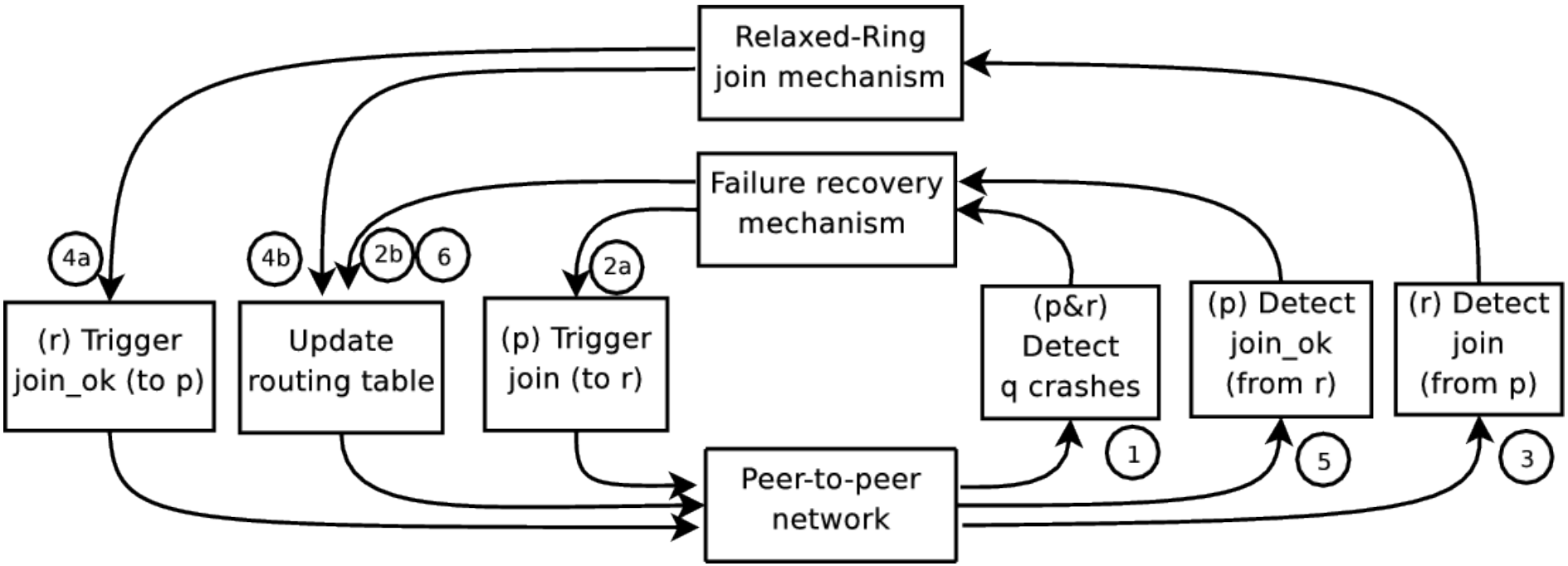
- Events perturbing the stability of the ring are constantly monitored
- Corresponding corrective actions are triggered
- Resilient information (successor list) is always updated

Failure Recovery as a Feedback Loop



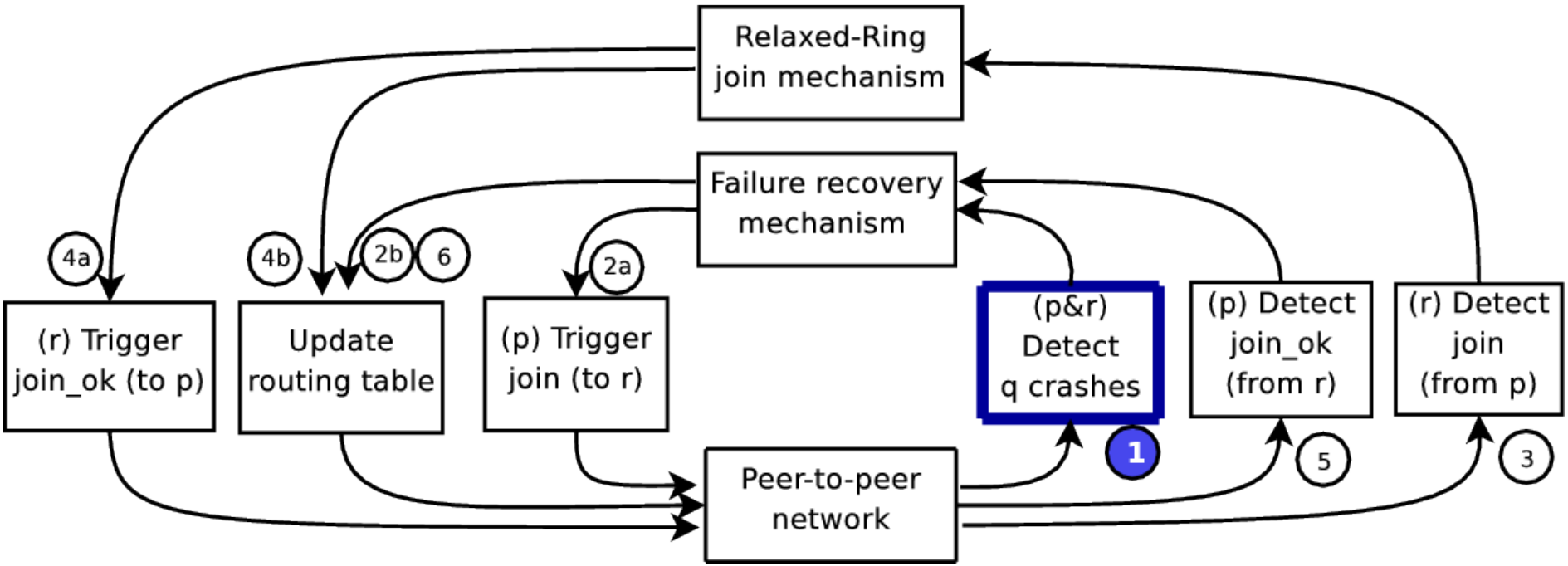
- Failures are perturbations on the relaxed-ring topology
- Join mechanism is triggering for fixing

Interaction of Loops in the Recovery Mechanism



- Peers *p* and *r* detect failure of *q*, fixing the ring with an interaction of feedback loops

Interaction of Loops in the Recovery Mechanism



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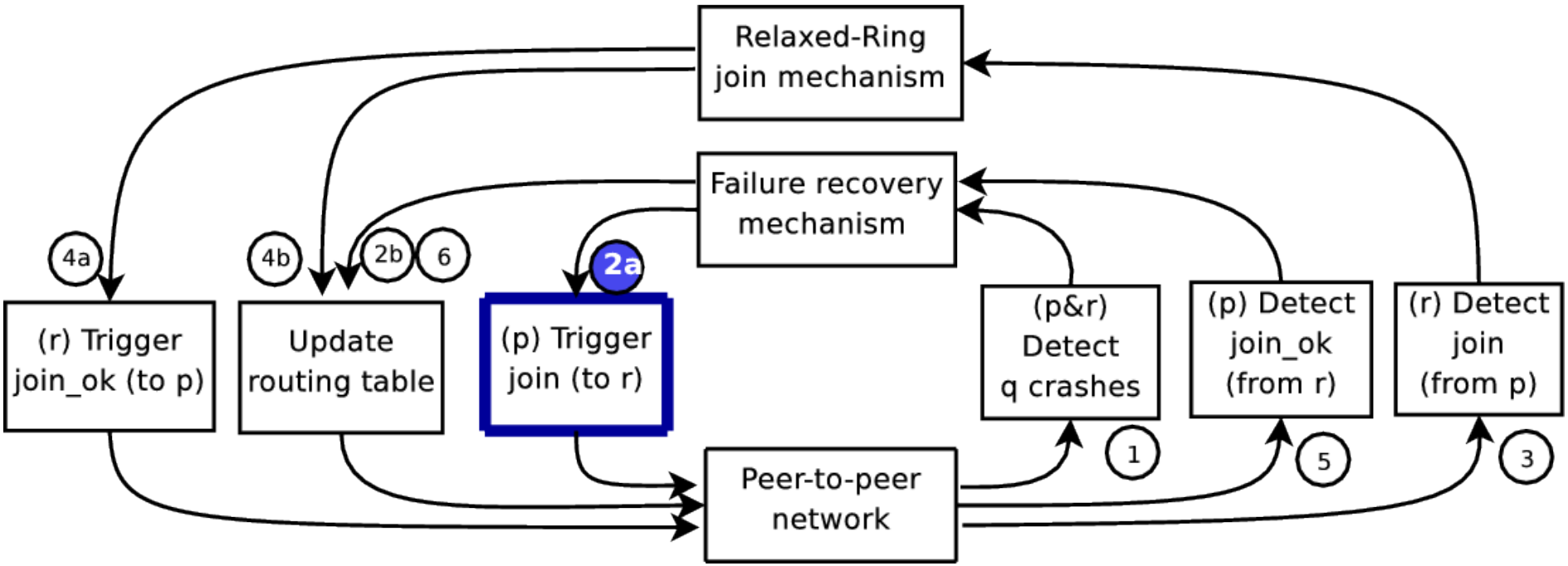

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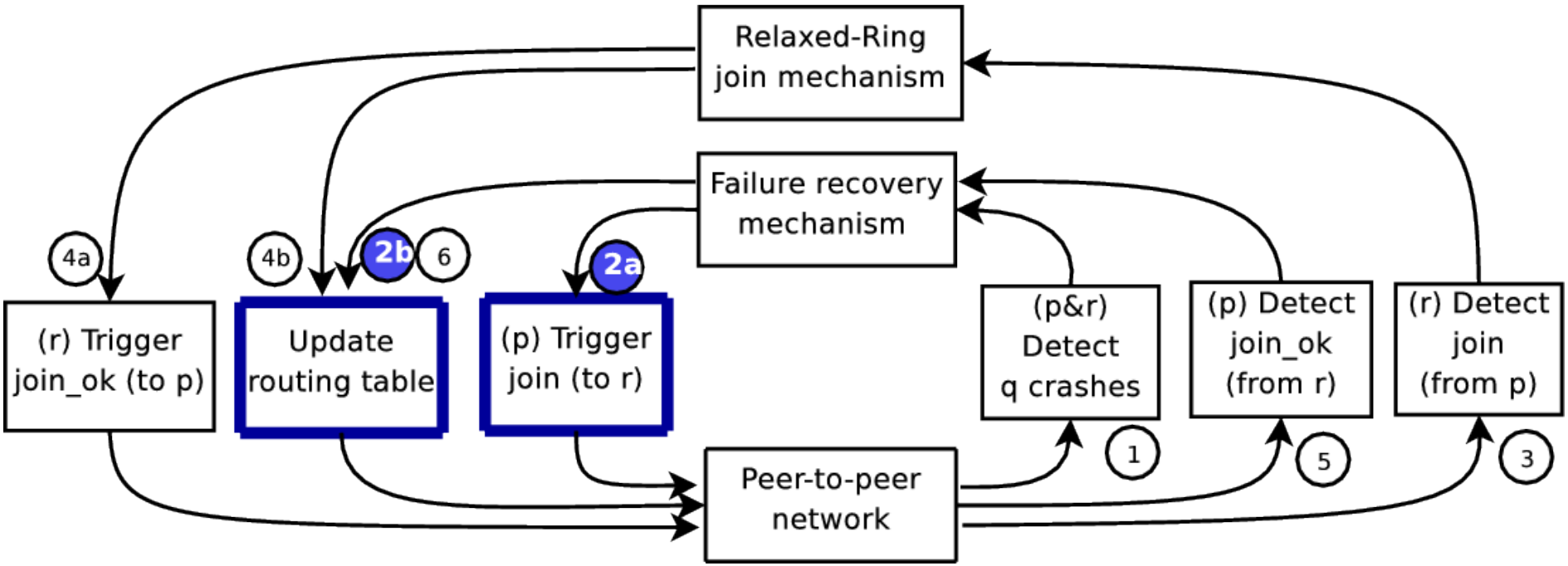

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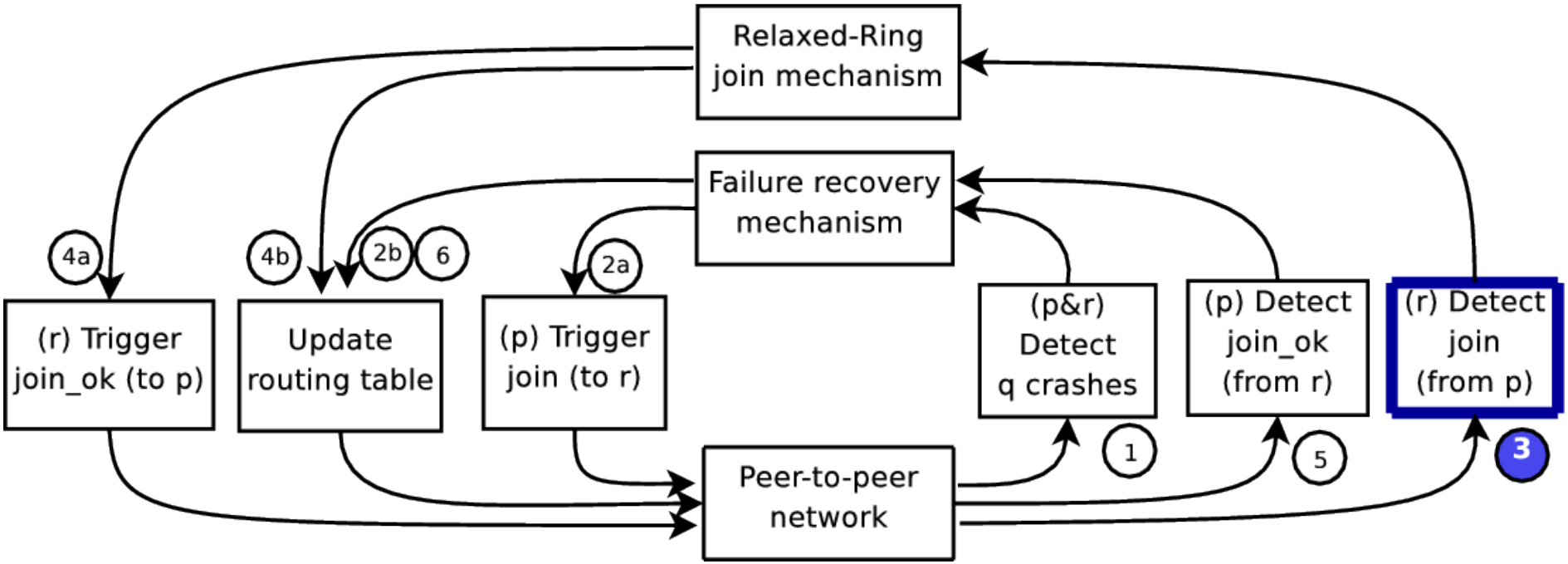

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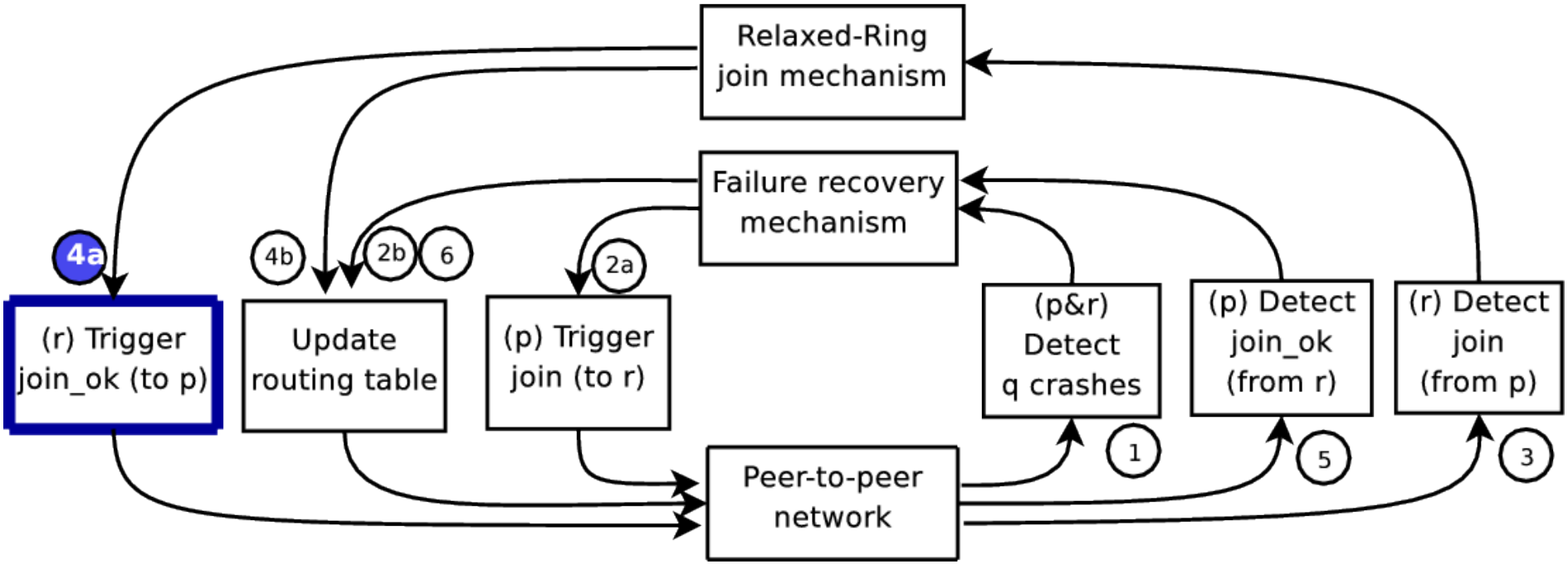

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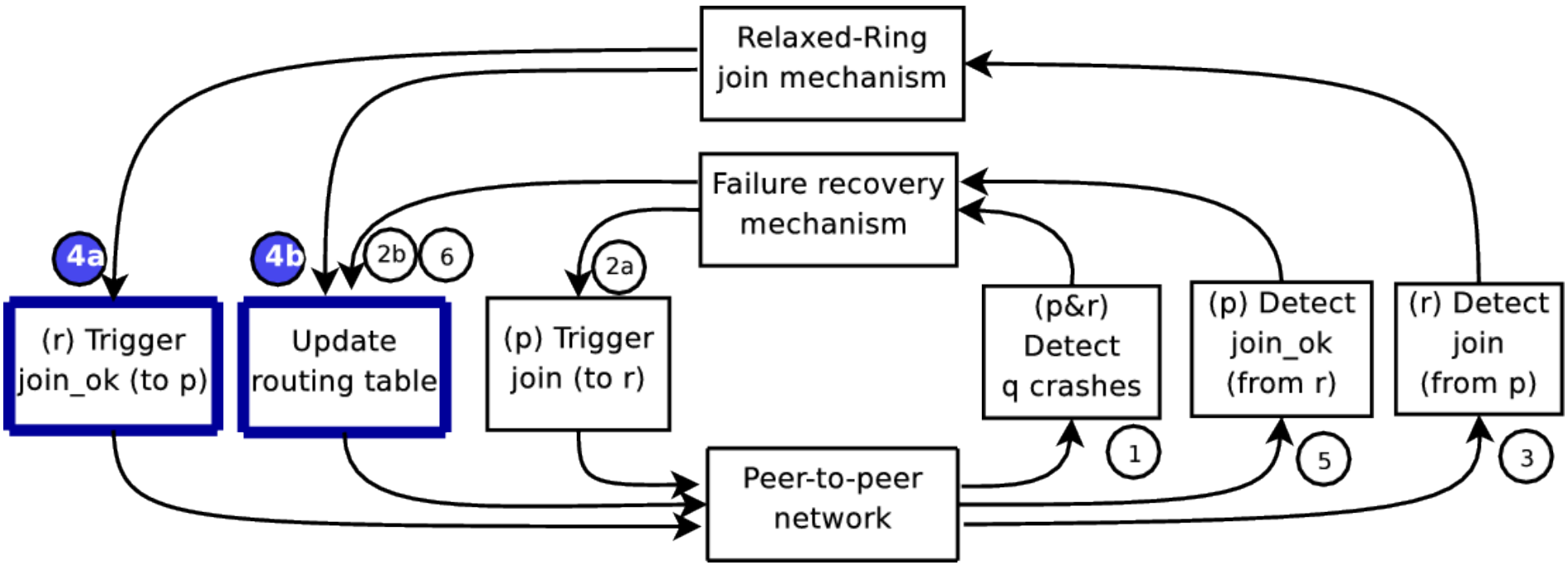

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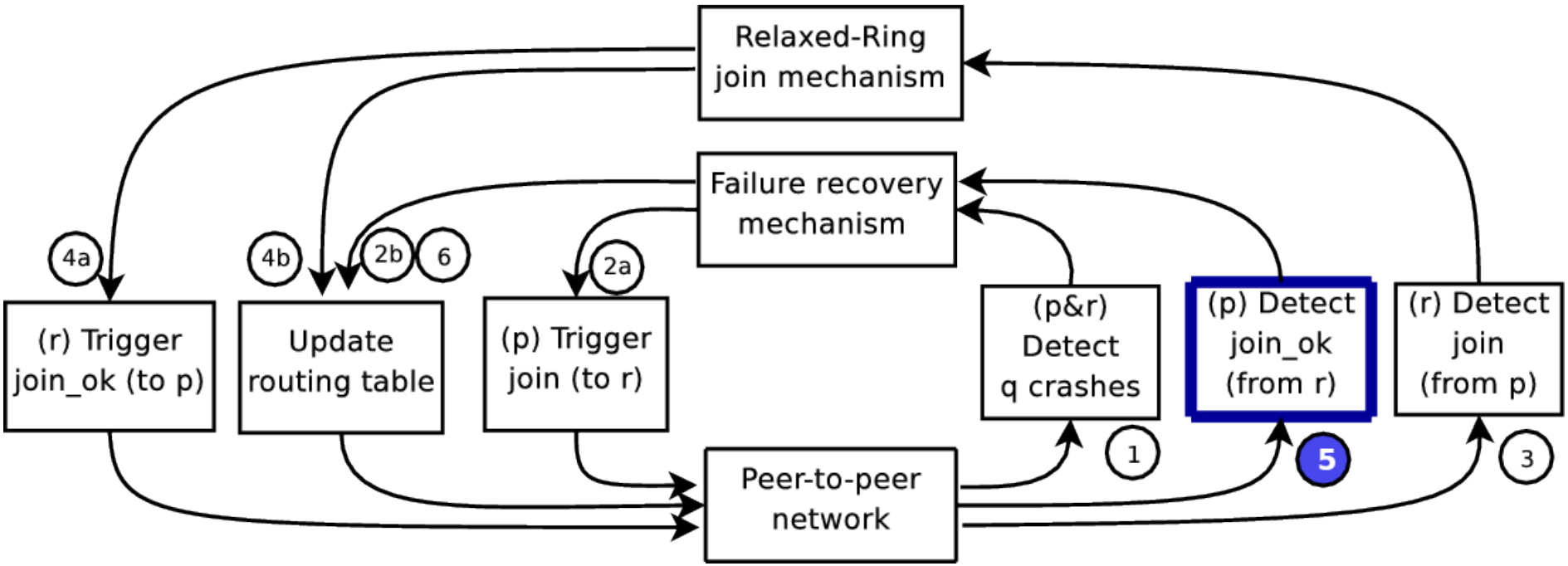
Interaction of Loops in the Recovery Mechanism



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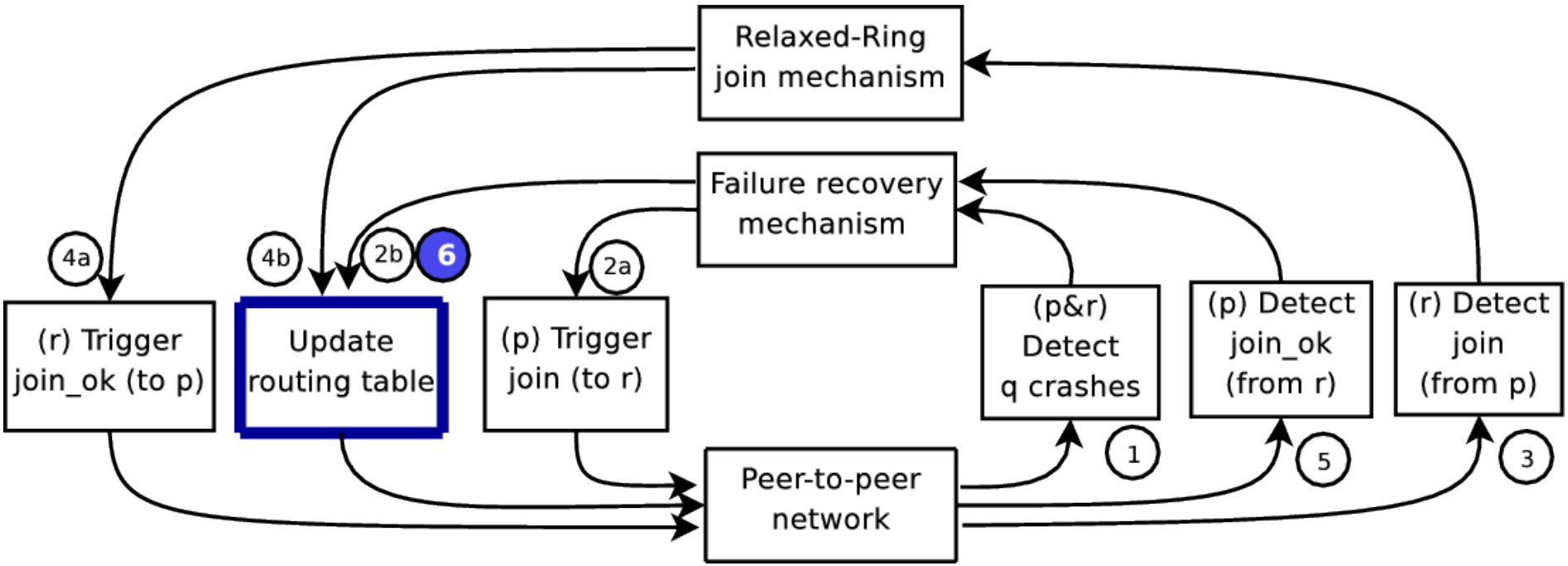
Interaction of Loops in the Recovery Mechanism



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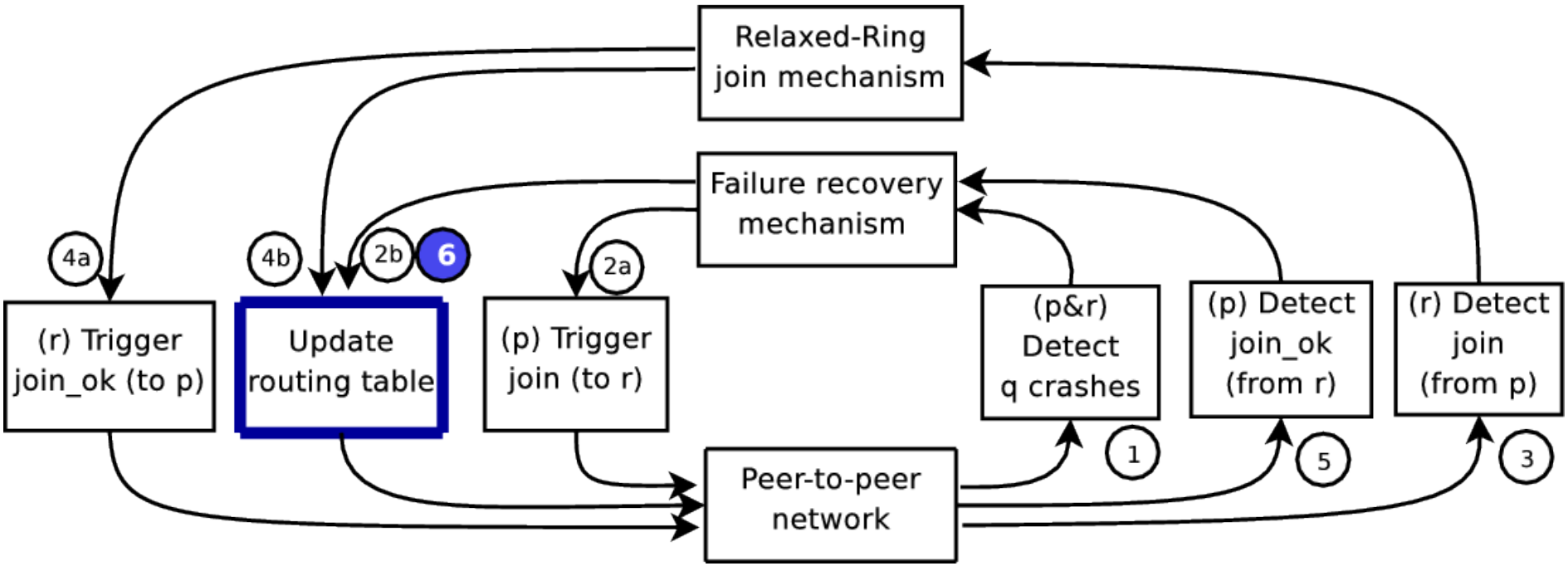

- Peers *p* and *r* detect failure of *q*, fixing the ring with an interaction of feedback loops
- Solving failure handling there is no need for handling *leaves*. They are just *explicit* failures

Beernet

- Mozart-Oz implementation of the relaxed-ring (P2PS's successor)
- Component-based architecture
- Event-driven algorithms with asynchronous message passing and no shared state concurrency
- DHT + Symmetric replication
- Transaction layer with Paxos consensus algorithm (M. Moser)
- Survives network partition
- Ring merge based on gossip algorithm (T. Mahmood)

Conclusion

- The Relaxed-Ring
  - Consistent lookup
  - Realistic failure detection
  - Self-organisation: It handles joins/leaves of peers re-organising the network in a autonomous fashion.
  - Self-healing: It recovers from failures and survives network partitioning.
  - Algorithms designed using feedback-loops
  - Beernet implementation with transactional layer

Conclusion and Future Work

- The Relaxed-Ring
  - Consistent lookup
  - Realistic failure detection
  - Self-organisation: It handles joins/leaves of peers re-organising the network in a autonomous fashion.
  - Self-healing: It recovers from failures and survives network partitioning.
  - Algorithms designed using feedback-loops
  - Beernet implementation with transactional layer
- TODO
  - Implement an application with Beernet to conquer the world
  - Work on reversible phase transitions

Last slide where I should ask for *questions*
or simply put a big *question mark*