

Privacy-Preserving Spam-Protected Gossip-Based Routing

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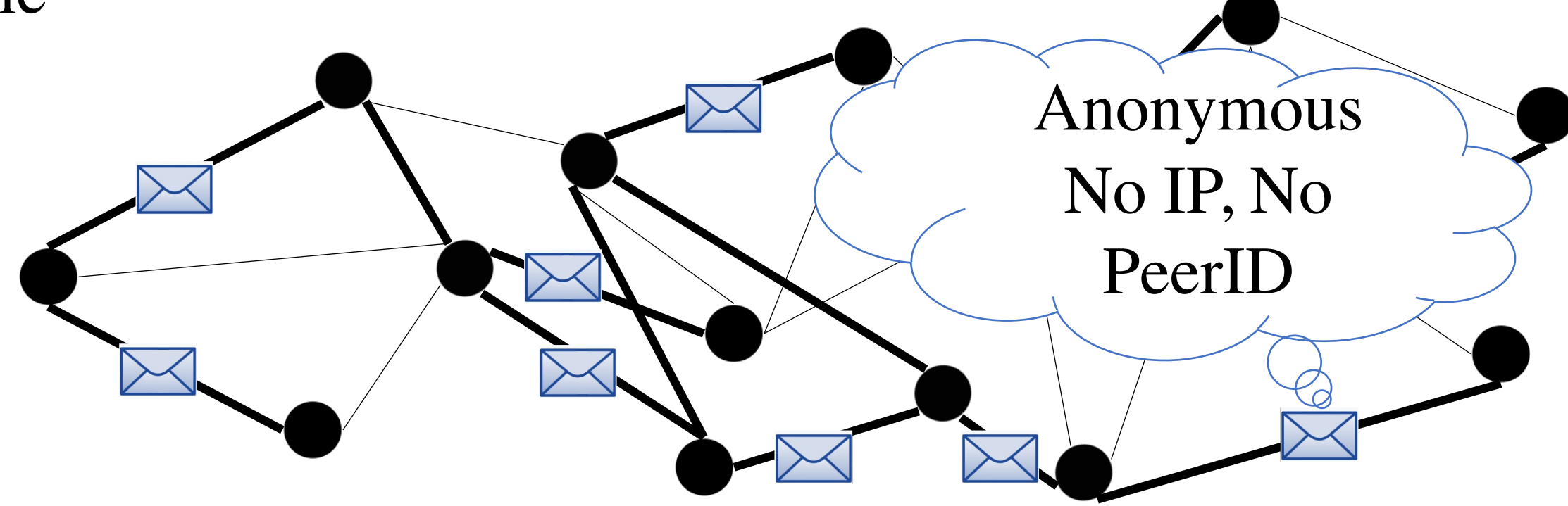
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WAKU2-RELAY: Anonymous P2P Gossip-Based Routing

WAKU2-RELAY [1] follows a Publisher-Subscriber Model with Gossip-based Routing (extension of libp2p GossipSub-v1.1 [2])

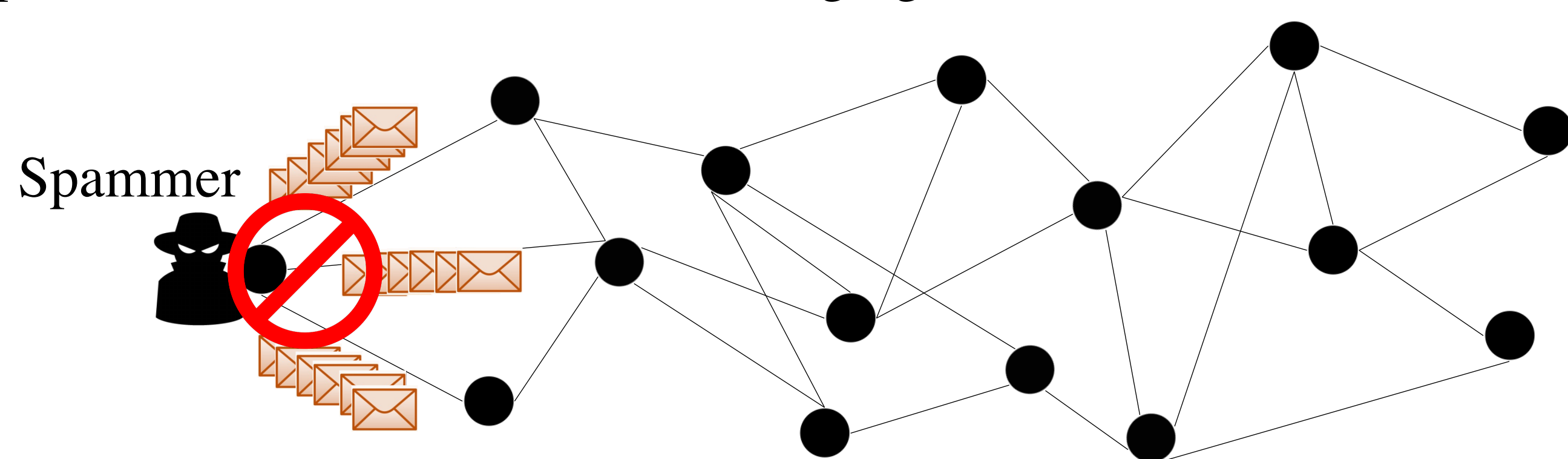
Messages are anonymous i.e. No Personally Identifiable information is available



Spam and Denial-of-Service Attack

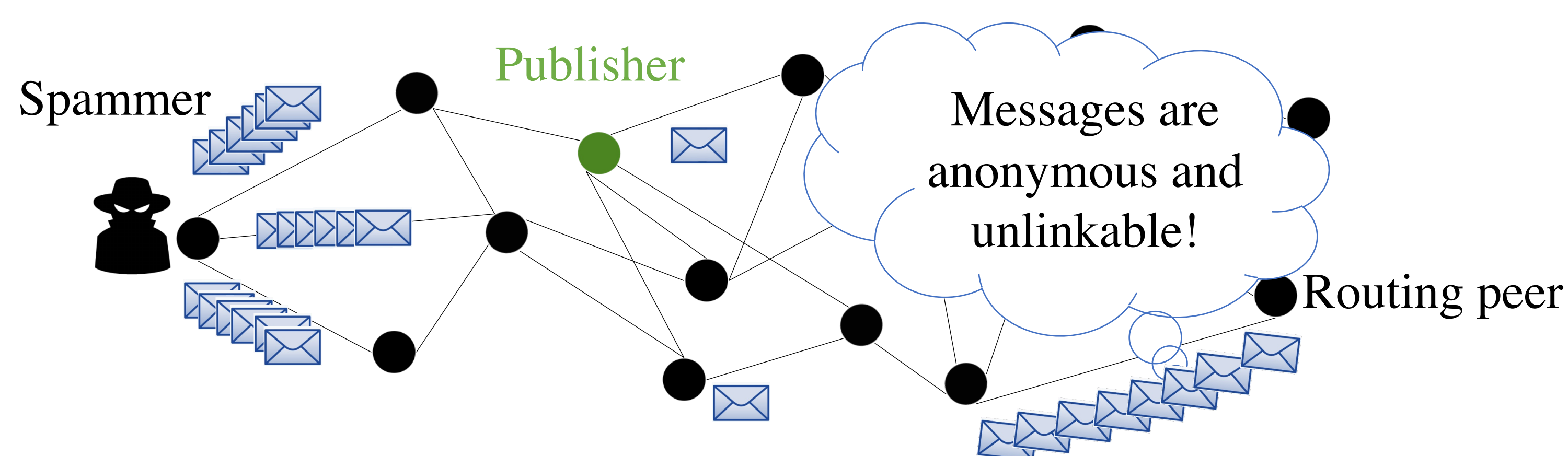
We define spammers as entities that publish a large number of messages in a short amount of time, and cause Denial-of-Service.

Spam Protection = Controlled Messaging Rate



Global Spam Protection and Anonymity

Routing peers can not distinguish spam messages from non-spam messages. Solutions like IP blocking are not effective.



Related Works

Proof-of-work [3] deployed by Whisper [4]

- Computationally expensive
 - Not suitable for network of heterogeneous peers with limited resources
- Peer Scoring [2] in libp2p
- Local to each peer
 - No global identification of spammer
 - Subject to inexpensive attacks using bots

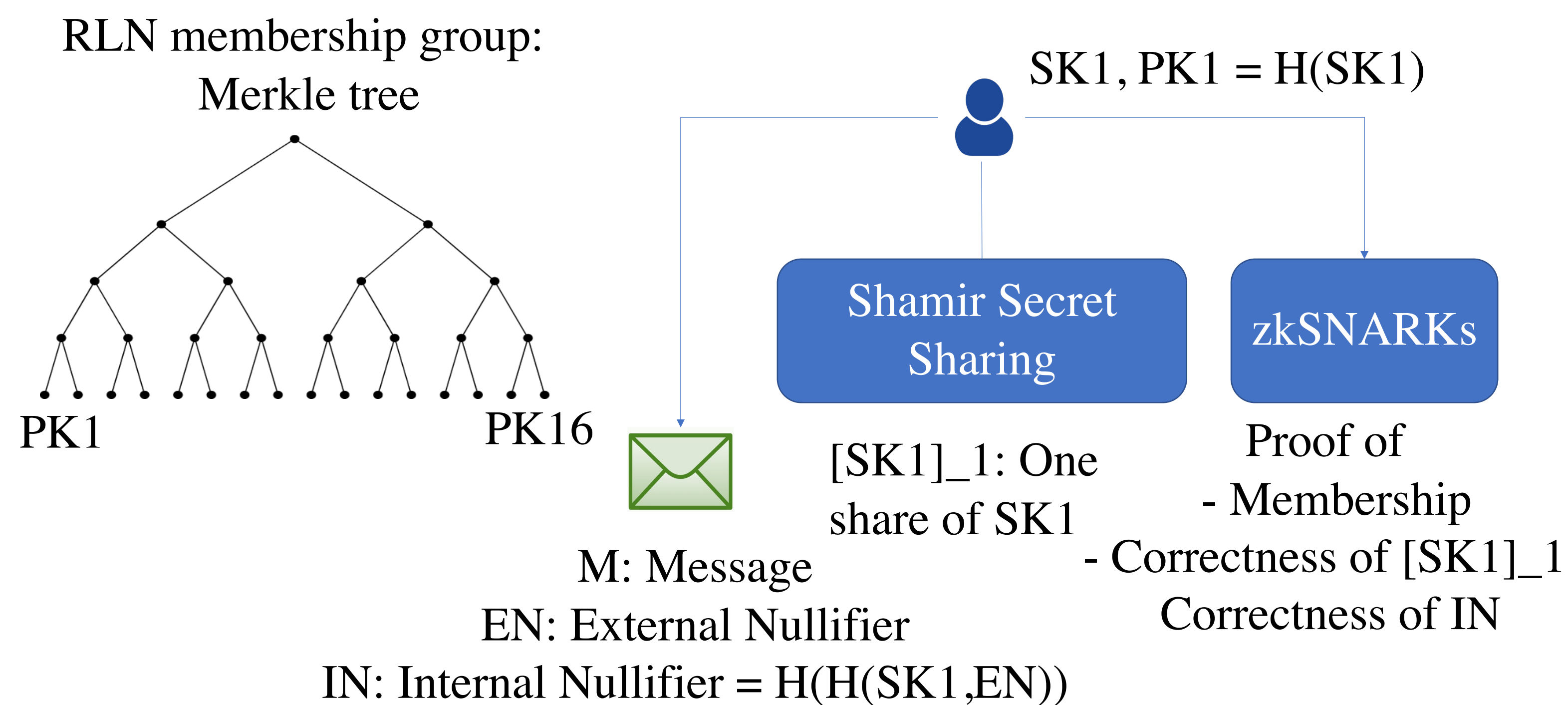
WAKU2-RLN-RELAY

WAKU2-RLN-RELAY [6] = WAKU2-RELAY + Rate Limiting Nullifiers [5]

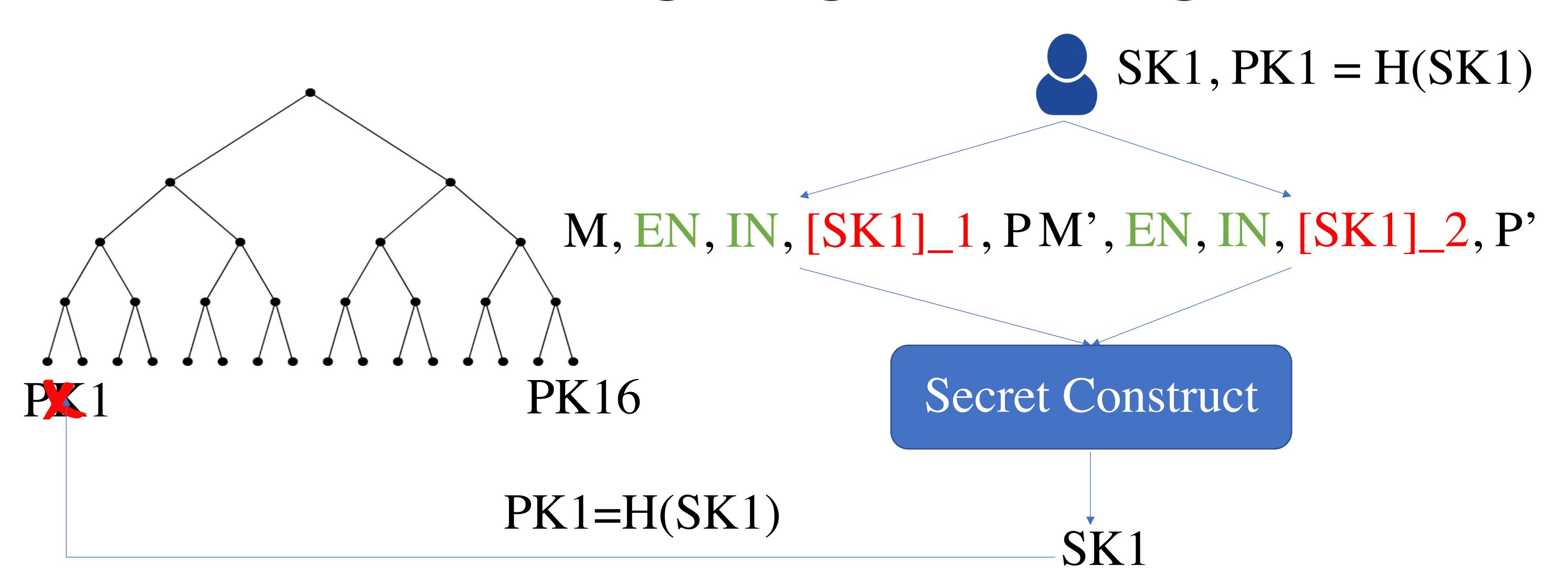
- A protocol-level P2P solution
- Computationally efficient and suitable for resource-restricted devices
- Privacy-preserving
- Global spam protection
- Sybil attack mitigation
- Built-in economic incentives where spammers are financially punished and those who find spammers are rewarded.

RLN: Rate Limiting Nullifier

Anonymous Signaling



Double Signaling and Slashing



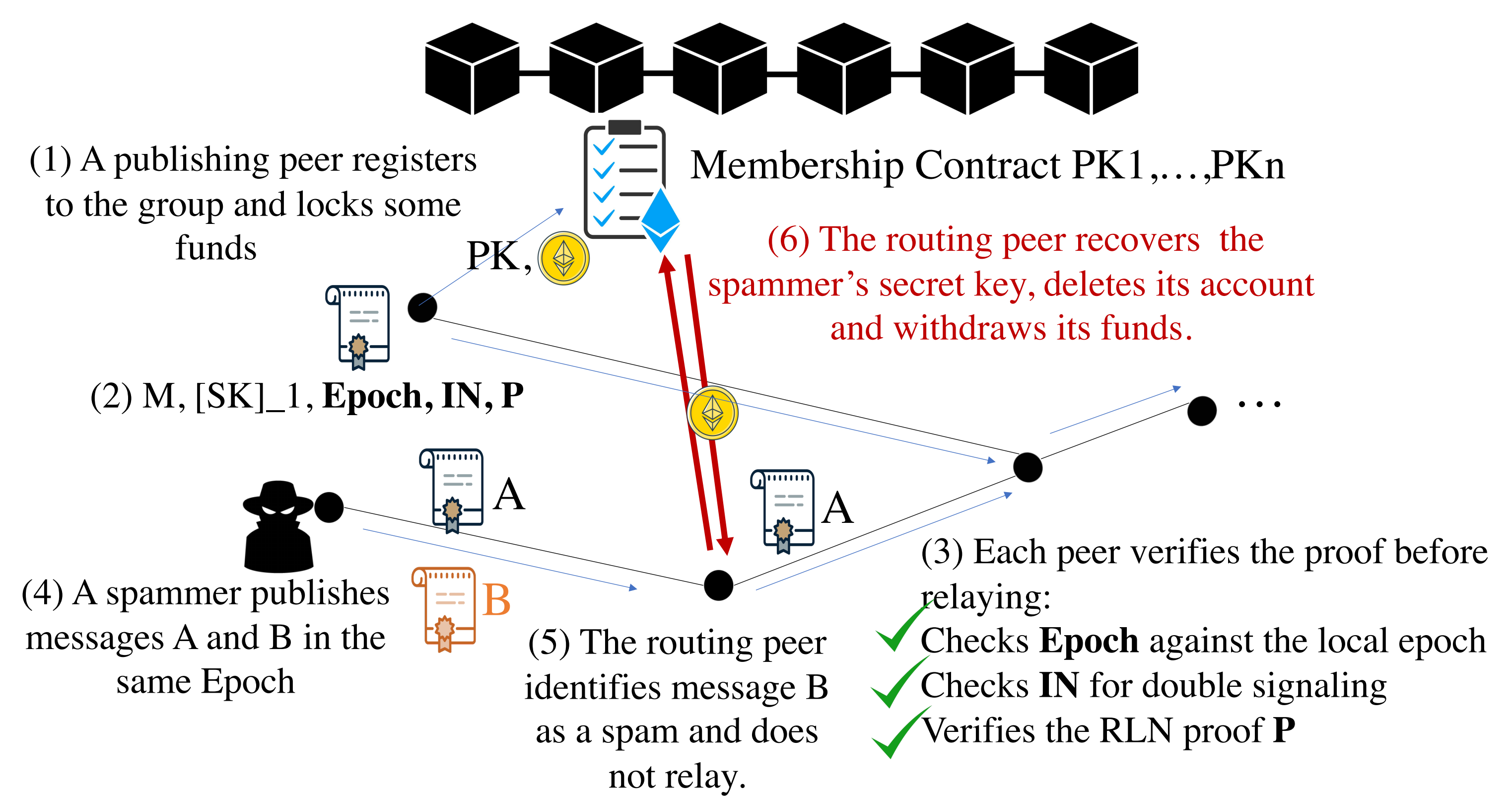
WAKU2-RLN-RELAY: Spam-Protected Gossip-Based Routing

RLN group: Peers subscribed to the same topic

External Nullifier/Epoch: the number of T seconds that elapsed since the Unix epoch. Each peer locally keeps track of the current epoch.

Messaging rate: 1 per Epoch.

Merkle Tree: Peers construct and update the Membership Merkle tree locally using events emitted from the membership contract.



Future Works

Benchmarking

Storage-efficient Merkle tree storage

- P2p network of full-nodes and light-nodes
- Partial view of Merkle tree

Real-time removal of spammers using off-chain/p2p solutions

Cost-effective way of member insertion and deletion using layer 2 solutions

References

1. WAKU2-RELAY specifications, <https://rfc.vac.dev/spec/11>
2. Vyzovitis D, Napora Y, McCormick D, Dias D, Psaras Y. GossipSub: Attack-resilient message propagation in the Filecoin and ETH2.0 networks. arXiv preprint arXiv:2007.02754. 2020 Jul 6.
3. C. Dwork and M. Naor, "Pricing via processing or combatting junk mail," in Annual international cryptology conference. Springer, 1992.
4. Whisper <https://eips.ethereum.org/eips/eip-627>
5. RLN specifications, <https://rfc.vac.dev/spec/32>
6. WAKU2-RLN-RELAY specifications, <https://rfc.vac.dev/spec/17>