

# Privacy-Preserving Spam-Protected Gossip-Based Routing

Sanaz Taheri

Vac Research and Development  
[sanaz@status.im](mailto:sanaz@status.im)

Oskar Thoren

Vac Research and Development  
[oskar@status.im](mailto:oskar@status.im)

Barry Whitehat

Unaffiliated  
[barrywhitehat@protonmail.com](mailto:barrywhitehat@protonmail.com)

Wei Jie Koh

Independent  
[contact@kohweijie.com](mailto:contact@kohweijie.com)

Onur Kilic

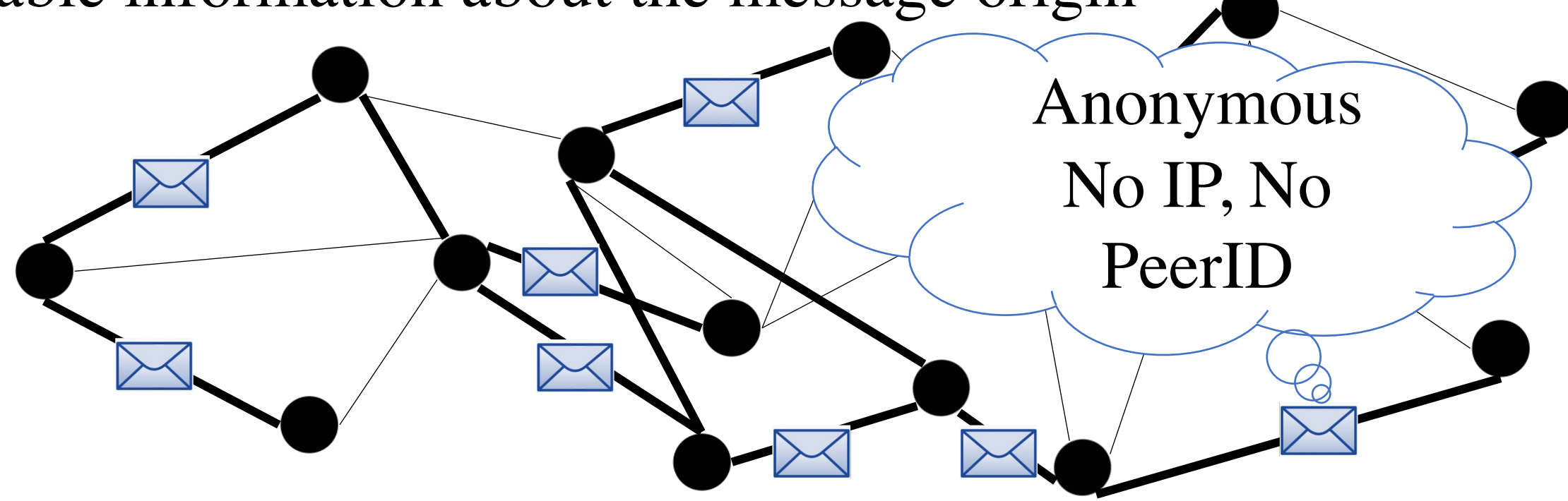
Unaffiliated  
[onurkilic@protonmail.com](mailto:onurkilic@protonmail.com)

Kobi Gurkan

eLabs  
[me@kobi.one](mailto:me@kobi.one)

## WAKU2-RELAY: Anonymous P2P Gossip-Based Routing

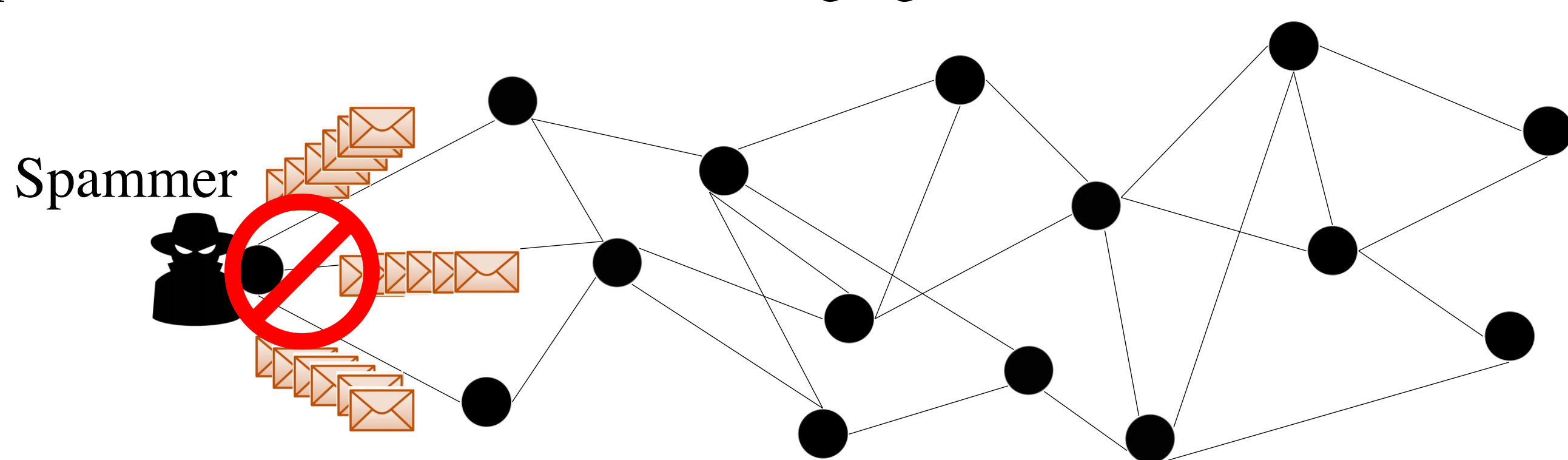
WAKU2-RELAY [1] follows a publisher-subscriber messaging model with gossip-based routing (extension of libp2p GossipSub-v1.1 [2]) Messages are anonymous i.e. protocol message headers carry no personally identifiable information about the message origin



## 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.

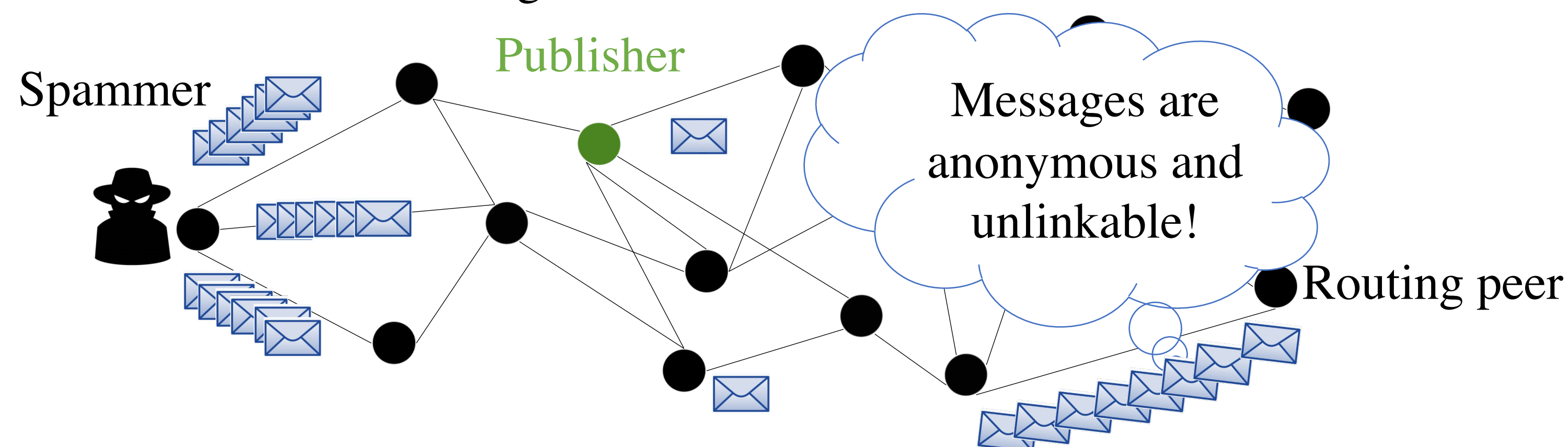
Spam Protection = Controlled Messaging Rate



## Global Spam Protection and Anonymity

Routing peers can not distinguish between spam messages and 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

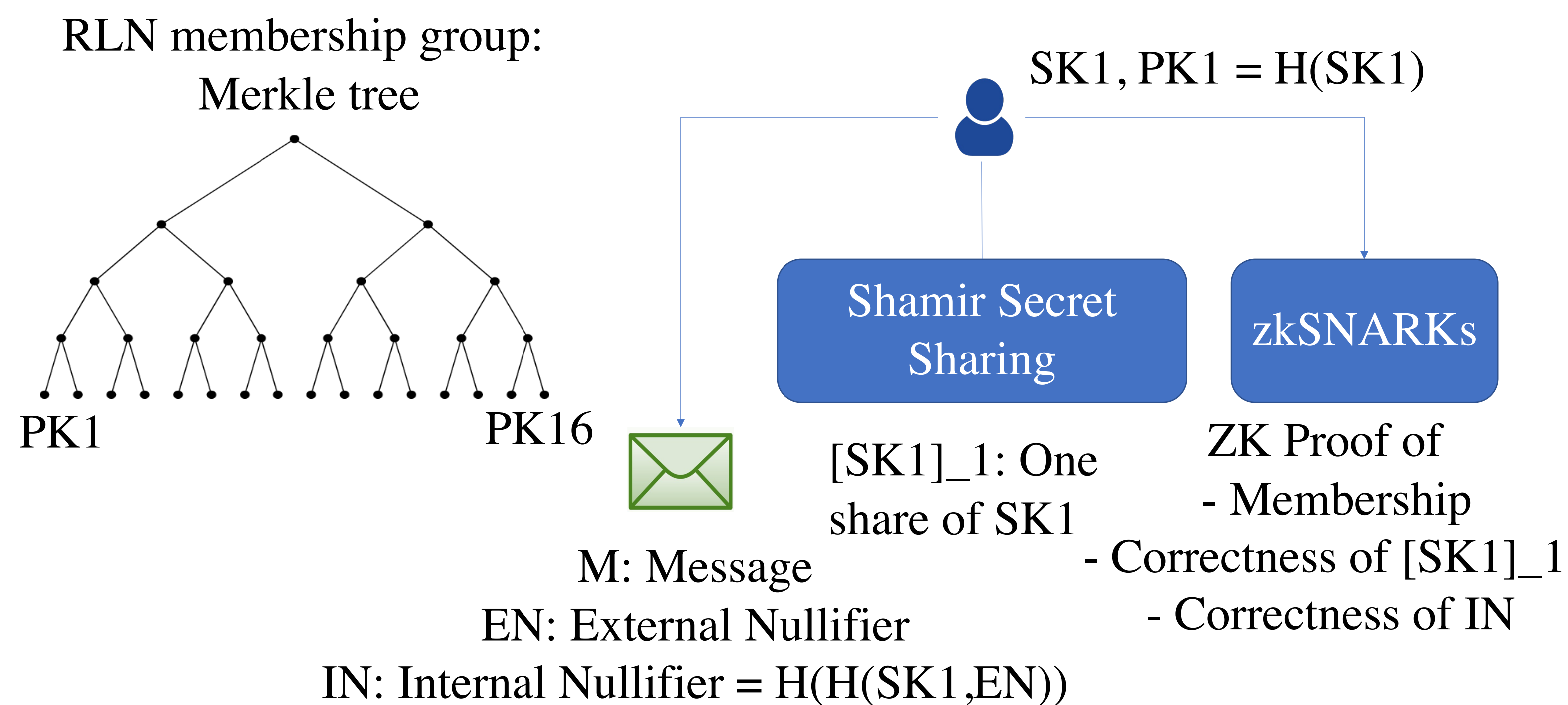
## WAKU2-RLN-RELAY

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

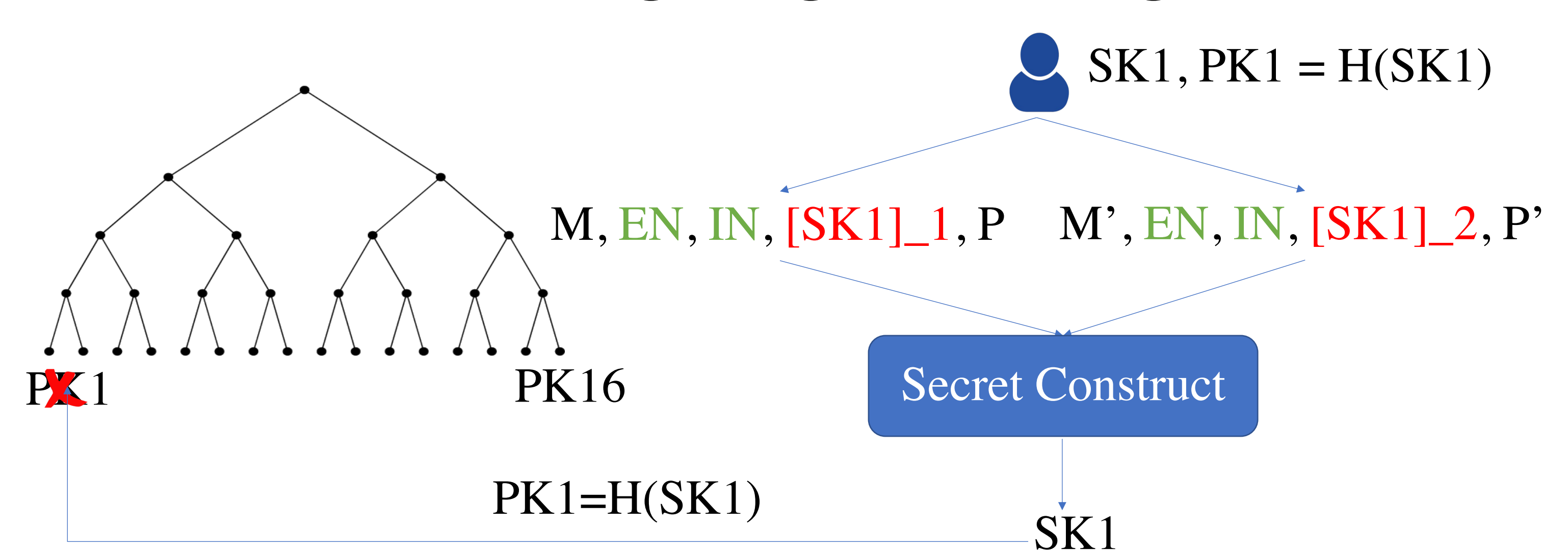
- A protocol-level solution
- Computationally efficient and suitable for resource-restricted devices
- Privacy-preserving
- Global spam protection
- Sybil attack mitigation
- Built-in economic incentives where spammers are financially punished and those who find spammers are rewarded.

## RLN: Rate Limiting Nullifier

### Anonymous Signaling



### Double Signaling and Slashing



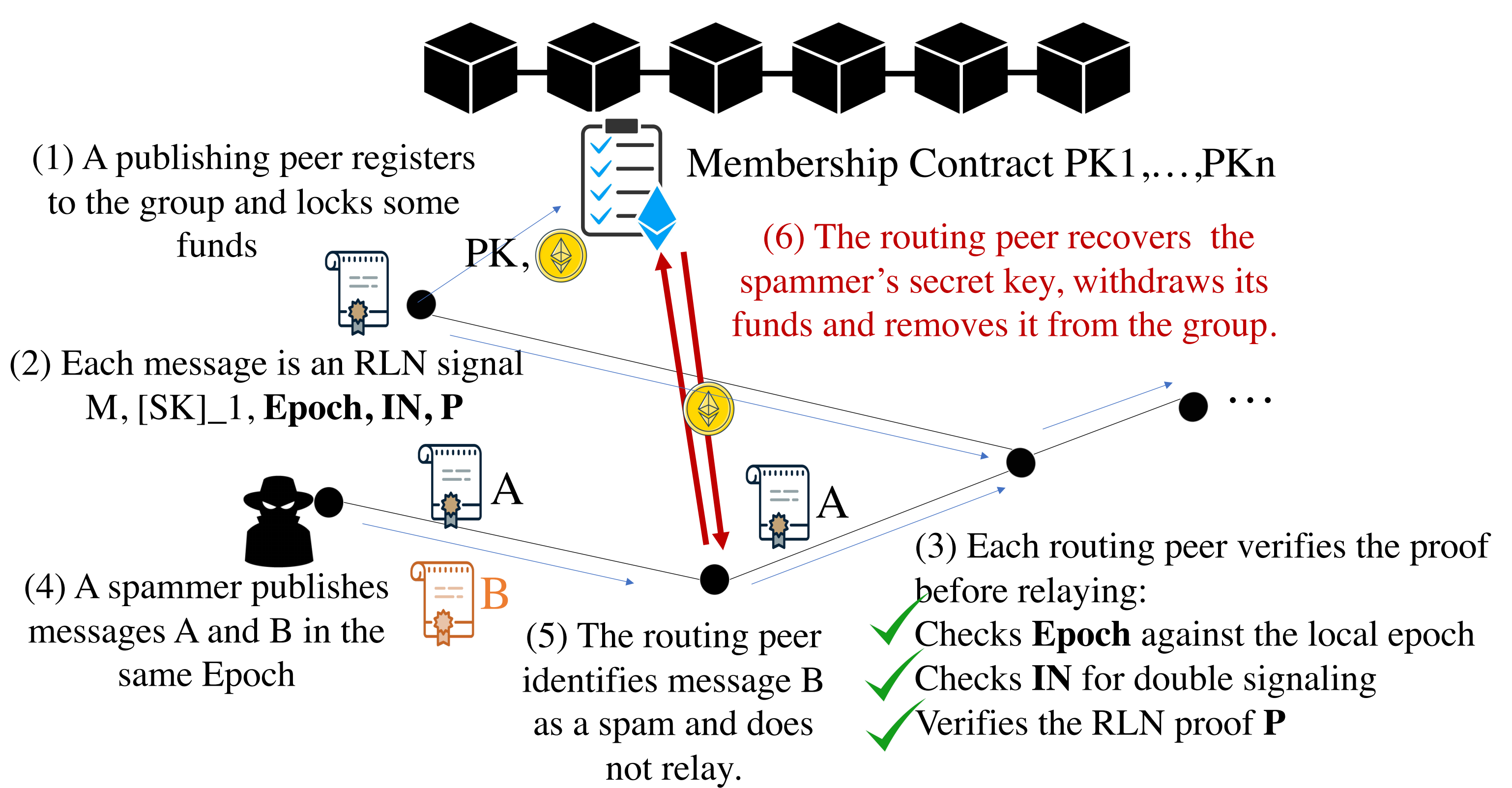
## WAKU2-RLN-RELAY: Spam-Protected Gossip-Based Routing

**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>