Non-Malleable Secret Sharing against Bounded Joint-Tampering Attacks in the Plain Model

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Sapienza University of Rome
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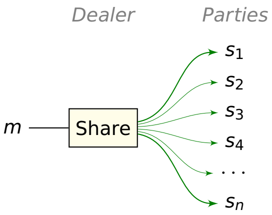
Online version

Secret Sharing



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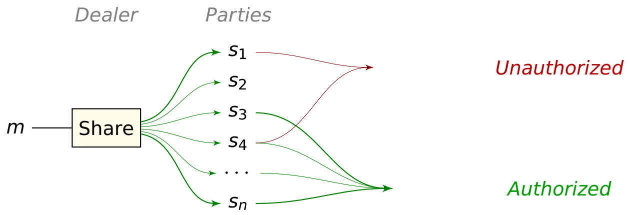

- **Access structure:** t-out-of-n

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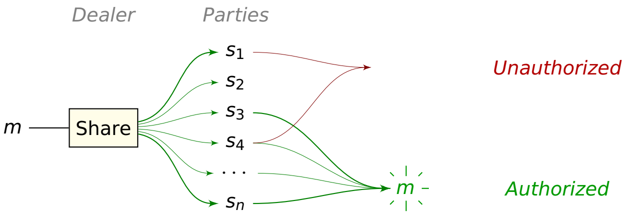

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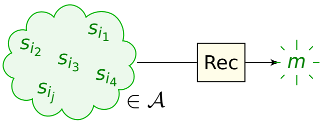

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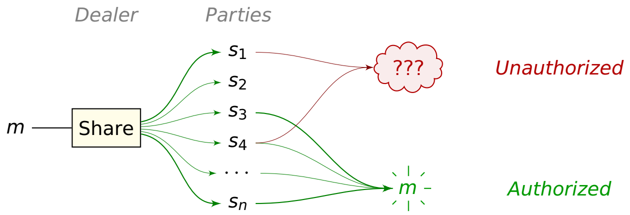

- **Access structure:** t-out-of-n
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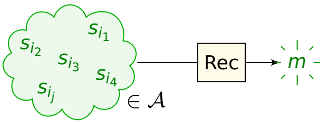
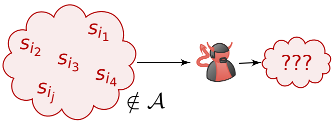
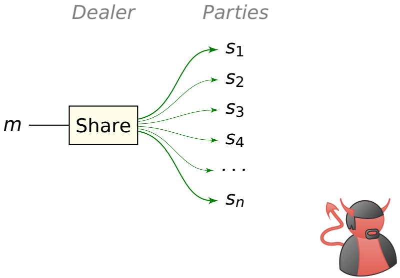
- **Privacy:** less than t parties should not be able to learn any information about the secret.





Leakage Resilient and Non-malleable Secret Sharing



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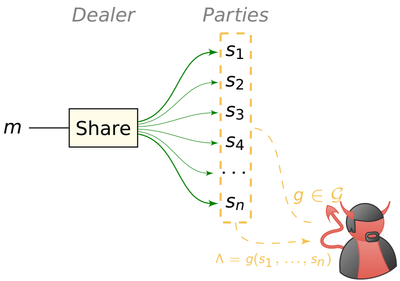

Side channel attacks: partial information from all the shares may reveal some information about the message!

SECURITY BREACH!

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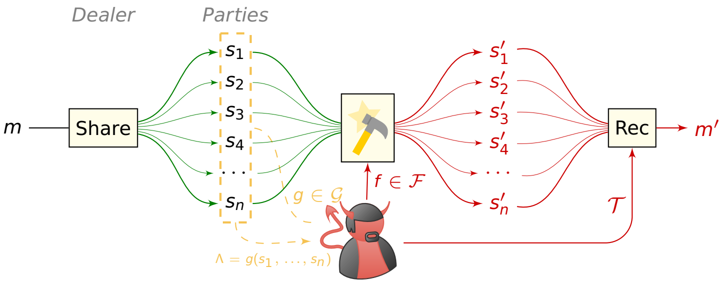

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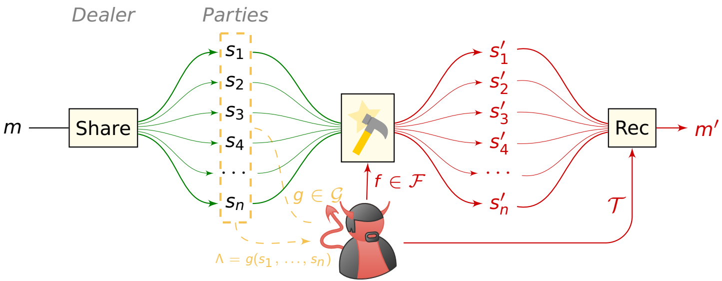

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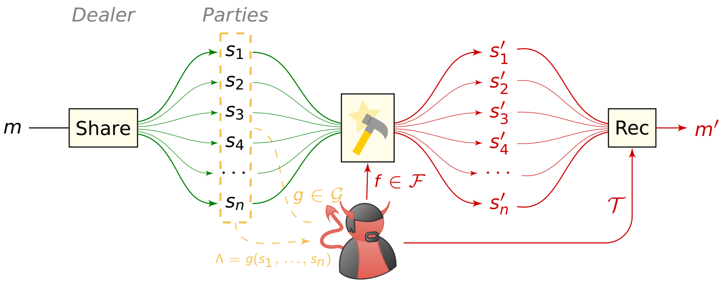

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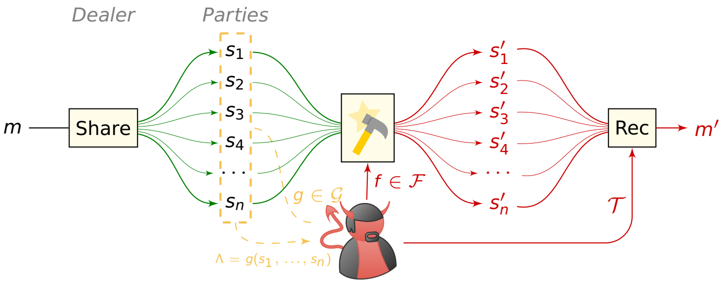

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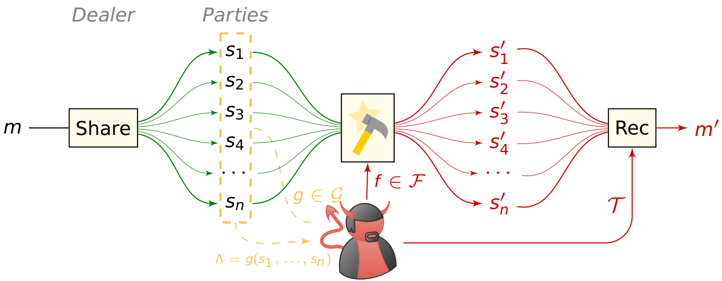

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Leakage-resilient non-malleability: the best of both worlds.
Limitations: Impossible for arbitrary families $\mathcal{G}$ and $\mathcal{F}$.

Our contributions

Our model

- Joint leakage and tampering (selective partitioning, semi-adaptive partitioning).

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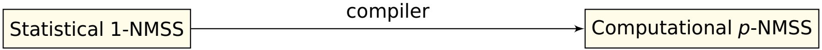
Both settings

- **Corollary:** construction of a p-time non-malleable secret sharing scheme from known techniques [OPVV18, BFV19].



Security against selective partitioning

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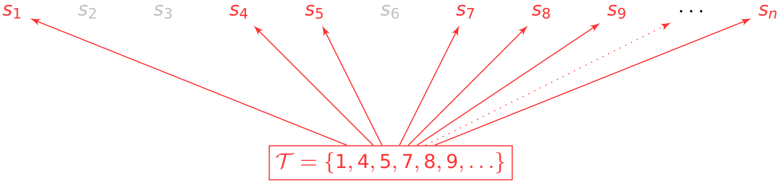

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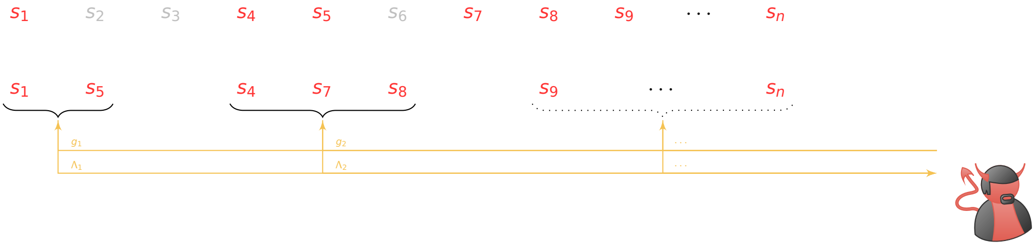

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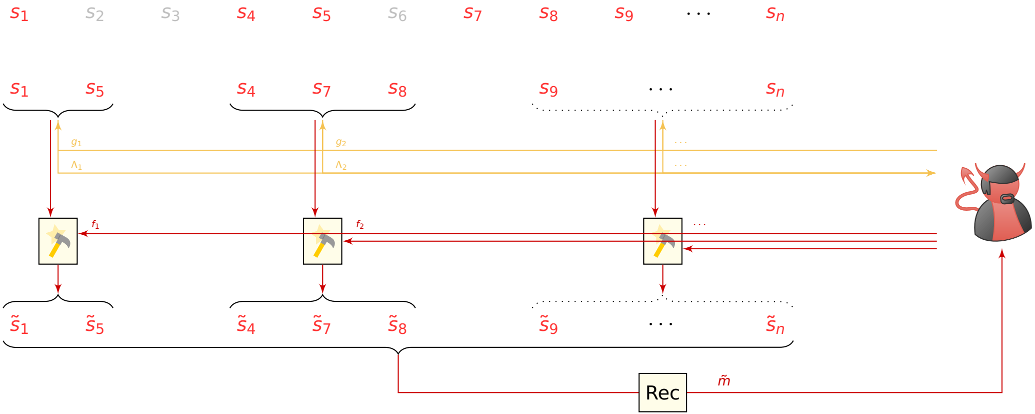

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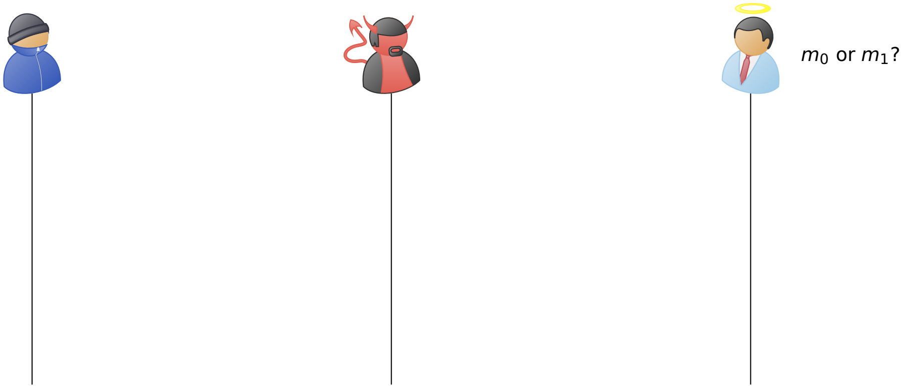

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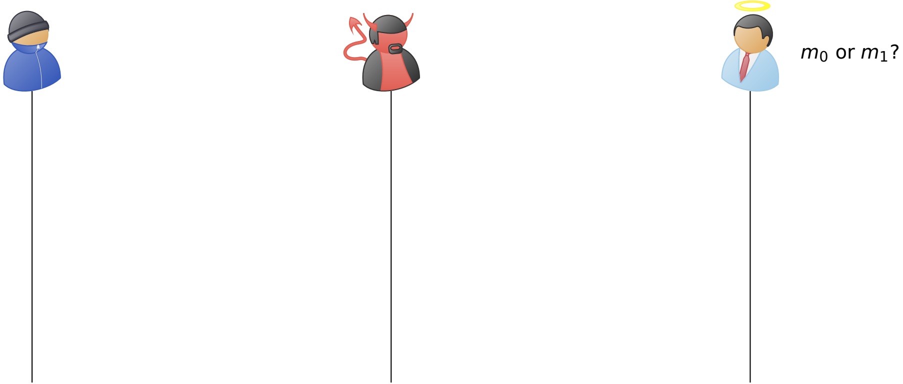

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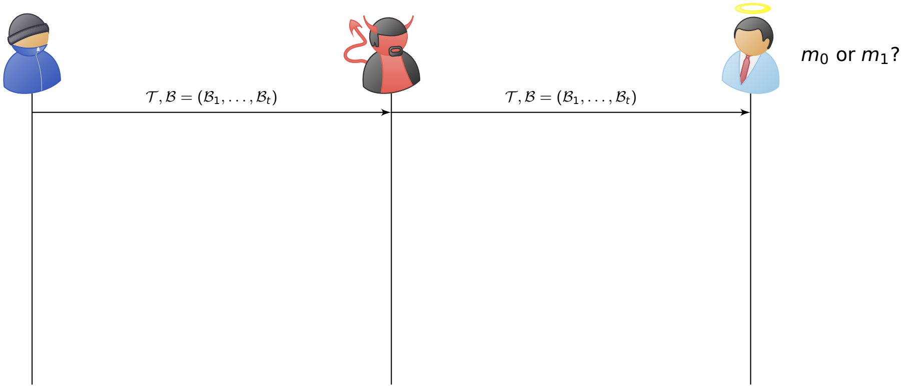

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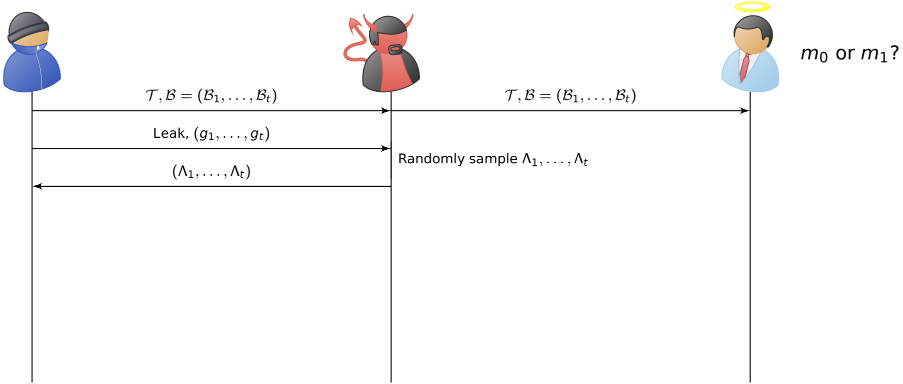

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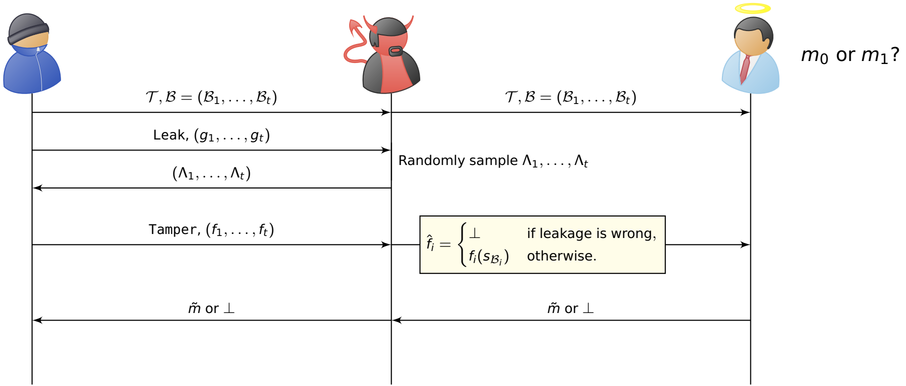

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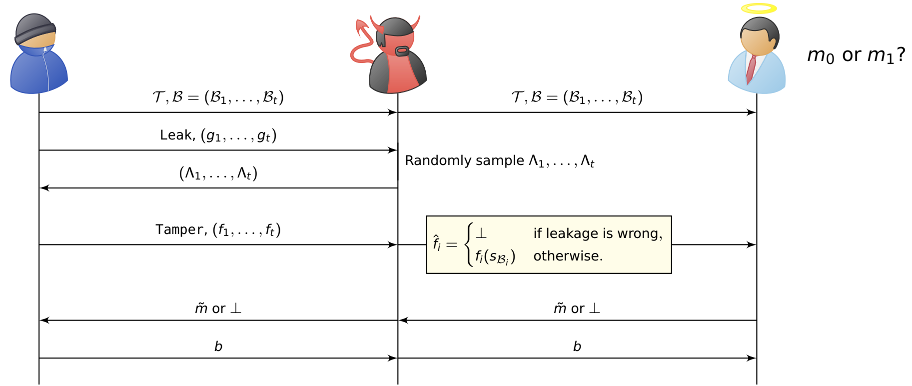

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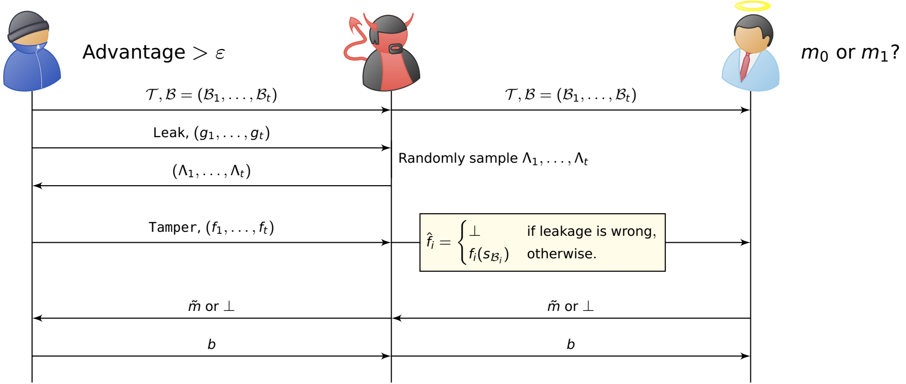

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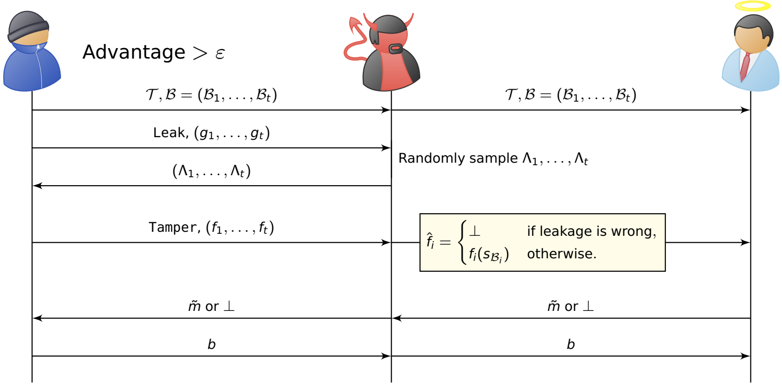

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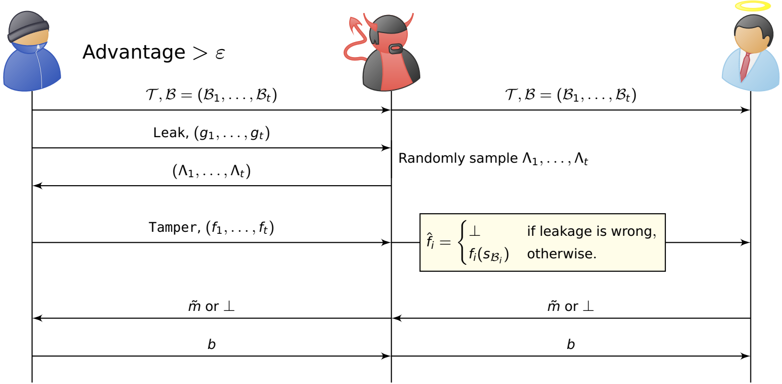

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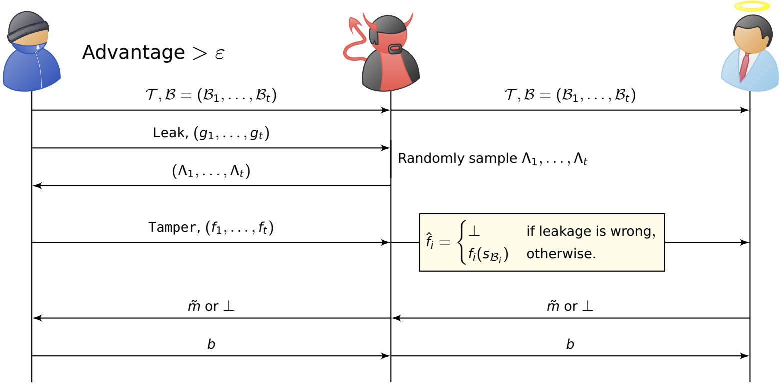

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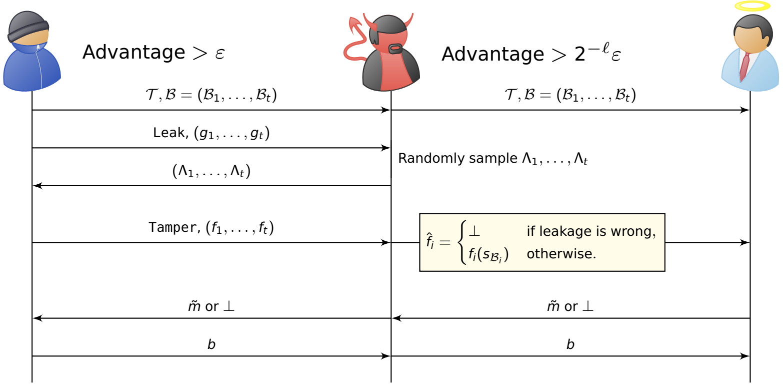

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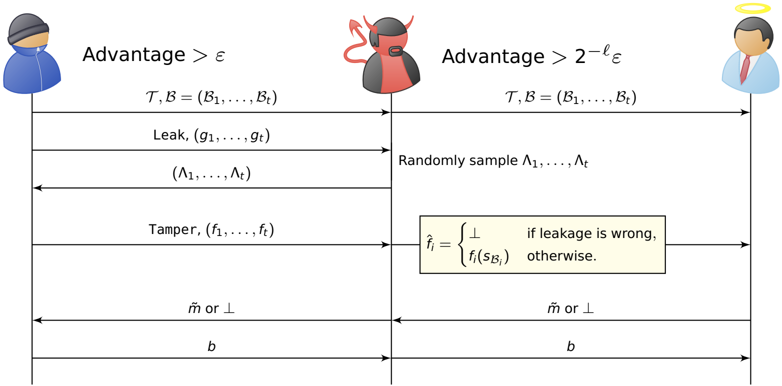

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Q.E.D.

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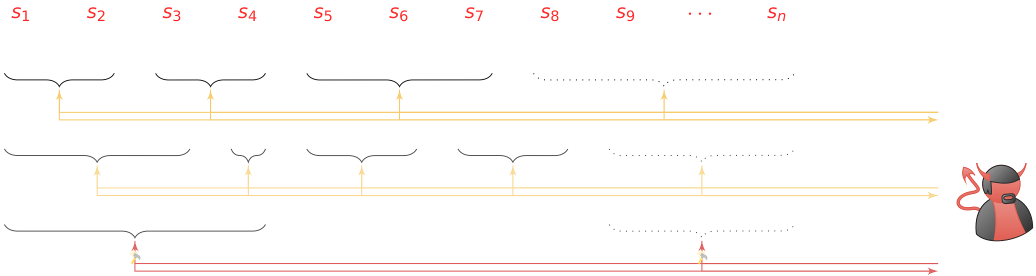

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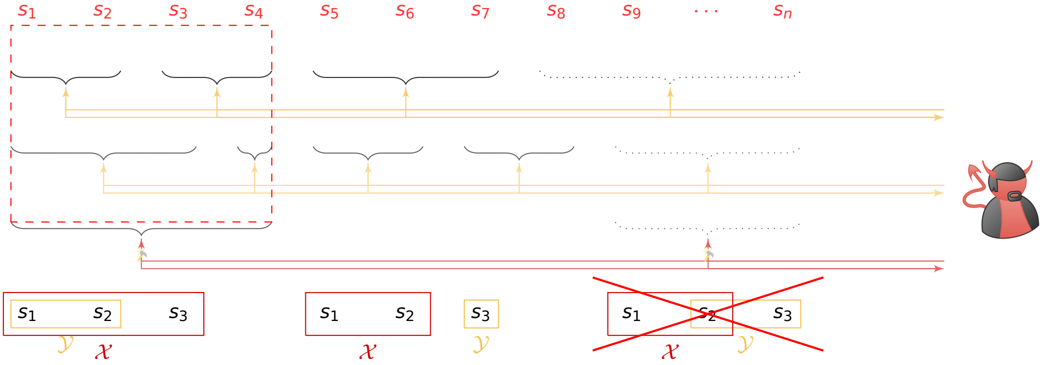

- The attacker only tampers within partitions whose subsets do not **partially** overlap with subsets belonging to leakage partitions.
- Much easier to achieve.

Our t-out-of-n semi-adaptive leakage-resilient non-malleable secret sharing

Construction inspired by [GK18]

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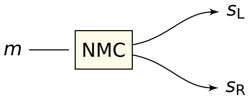

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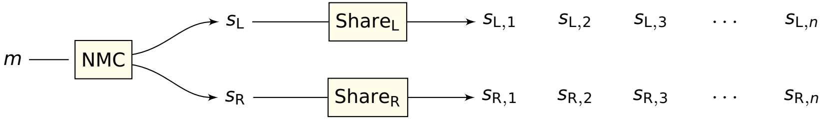

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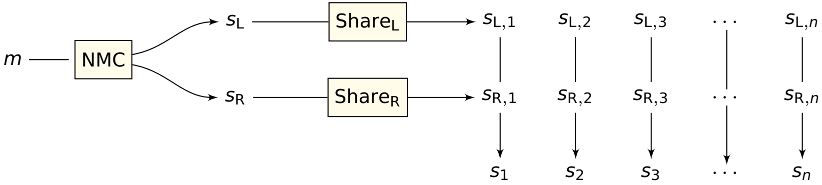

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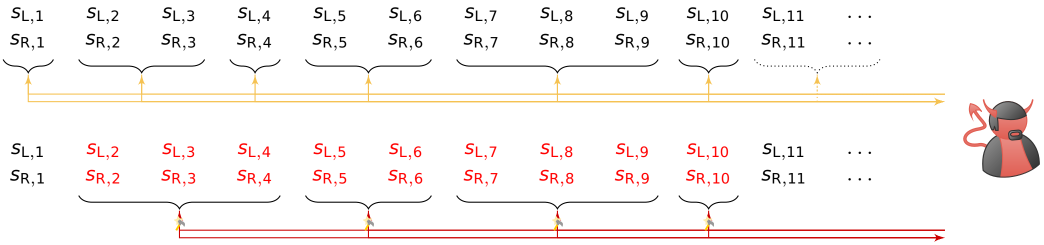
- Security proof inspired by [KMS18]
- We extend their result obtaining security against joint tampering with $k' - 1$ shares (instead of independent tampering).

Our semi-adaptive leakage-resilient non-malleable secret sharing – Proof strategy



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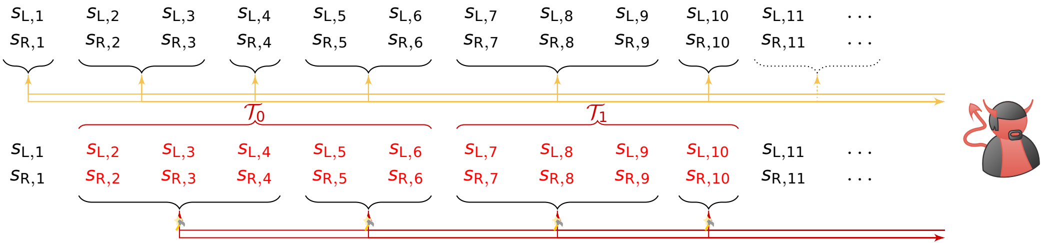

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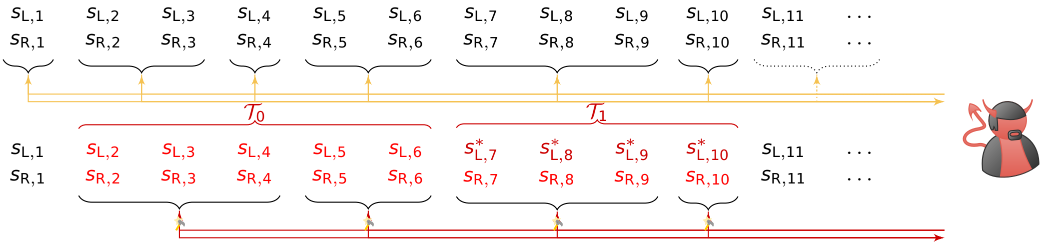

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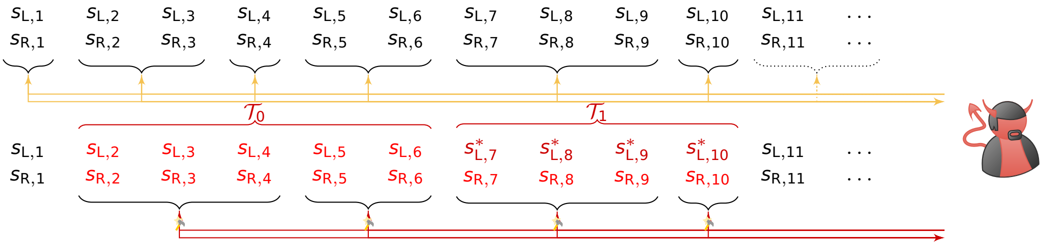

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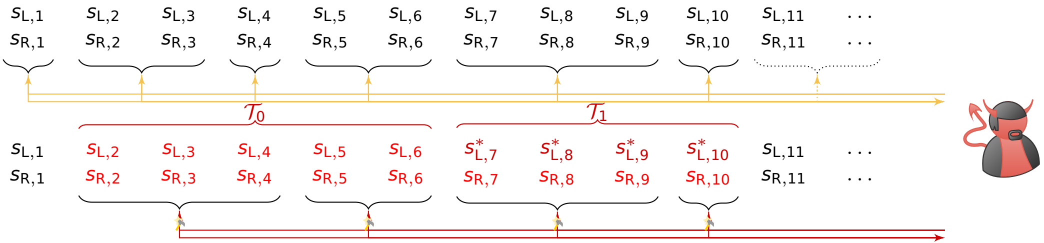

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  - This is because of each subset of each leakage partition containing only shares that are within at most one subset of the tampering partition.

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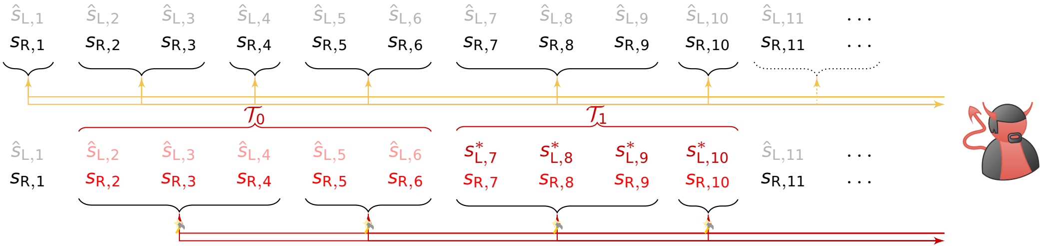

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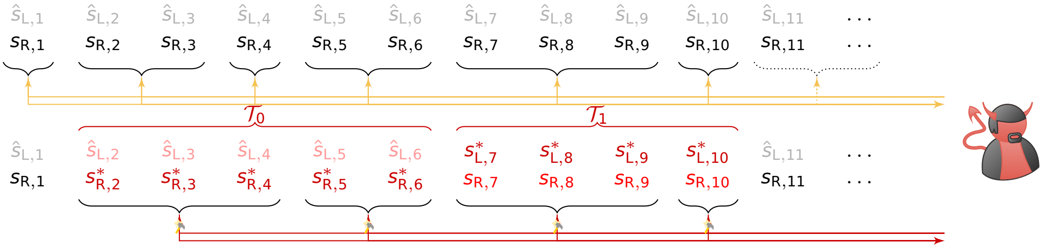
Our semi-adaptive leakage-resilient non-malleable secret sharing – Proof strategy



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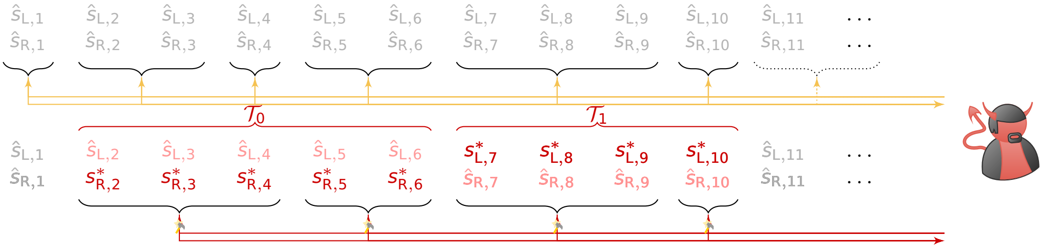

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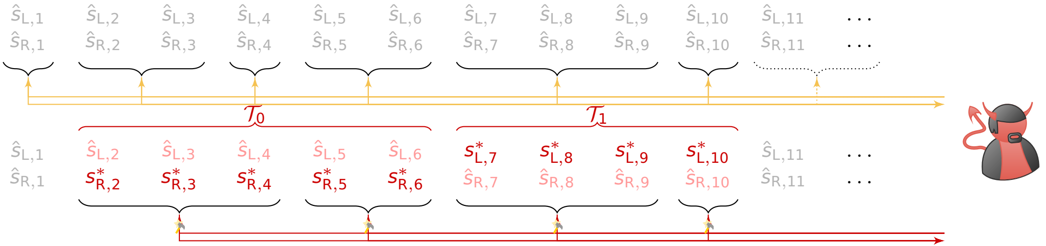

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- Now we can safely reduce to non-malleability of the non-malleable code.

Corollary: p-time non-malleability

Known techniques [OPVV18, BFV19], building blocks: Share, Com.

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Our results

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