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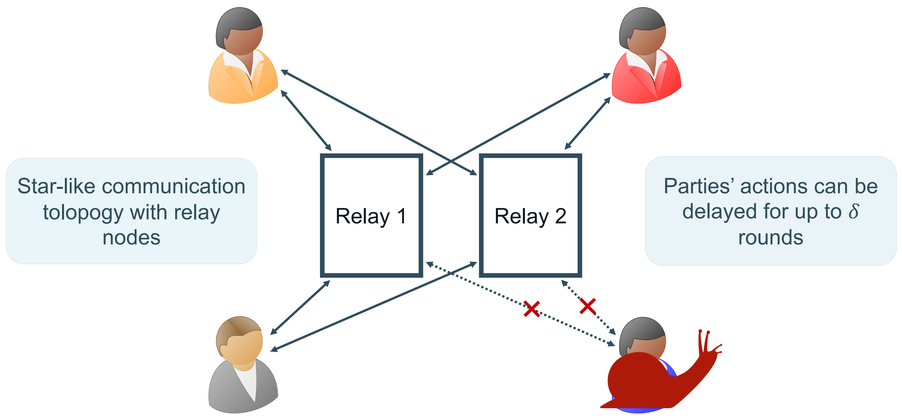
MPC with Delayed Parties Over Star-Like Networks

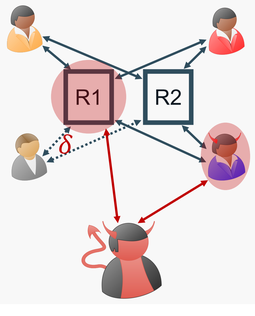


The protocol

- Based on Shamir Secret Sharing
- Multiplication with **1-round Damgård-Nielsen** protocol (using broadcast messages)
- **Active security** through circuit compilation as in Genkin et al. [GIP+14] (must be passively secure up to **additive attacks**)
- **Fast parties don't need to wait for delayed parties** (in the strong honest majority case)

The adversary

- Can corrupt up to $t < n/2$ parties (static corruption)
- Can corrupt all but one relay
- Can delay an arbitrary number of parties for up to δ rounds



Relay Interface

p2p messages

From party i to party j.

Commands:

Send: stores encrypted message to party j, round $k_{i,j}$
Request: retrieves message from i to j, round $k_{i,j}$
Erase: erases message from i to j, round $k_{i,j}$

Relay maintains:

- Pairwise message counter $k_{i,j}$
- Pairwise deleting counter $d_{i,j}$

Broadcast messages

From party i to all other parties.

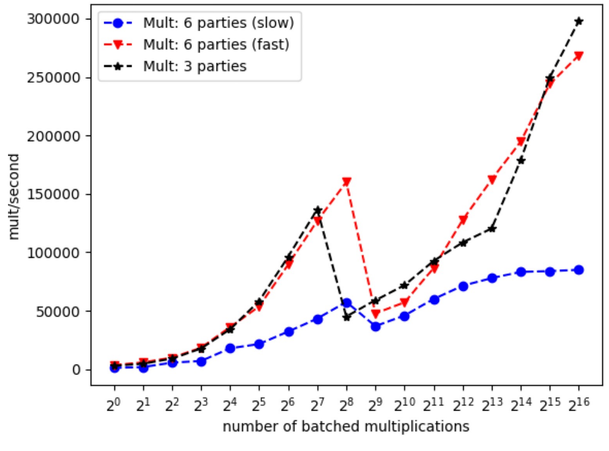
Commands:

SendToAll: stores plaintext message to all parties, round k^{all}
RequestFromAll: retrieves all messages for round k^{all}
EraseAll: erases all messages for round k^{all}

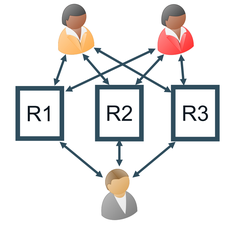
Relay maintains:

- Global message counter k^{all}
- Global deleting counter d^{all}

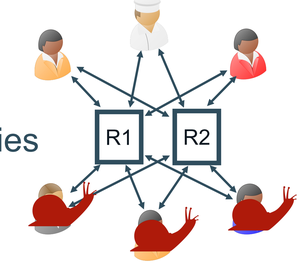
Cheap in a relay based network!



3 parties:
- At most 1 corruption



6 parties:
- At most 1 corruption
- 3 slow parties, 3 fast parties



Faster parties:
~270k multiplications/s