What is the Lightning Network?

eclair

LND

Orfeas Stefanos Thyfronitis Litos

University of Edinburgh

20,000 tx/s

7 tx/s

insta*

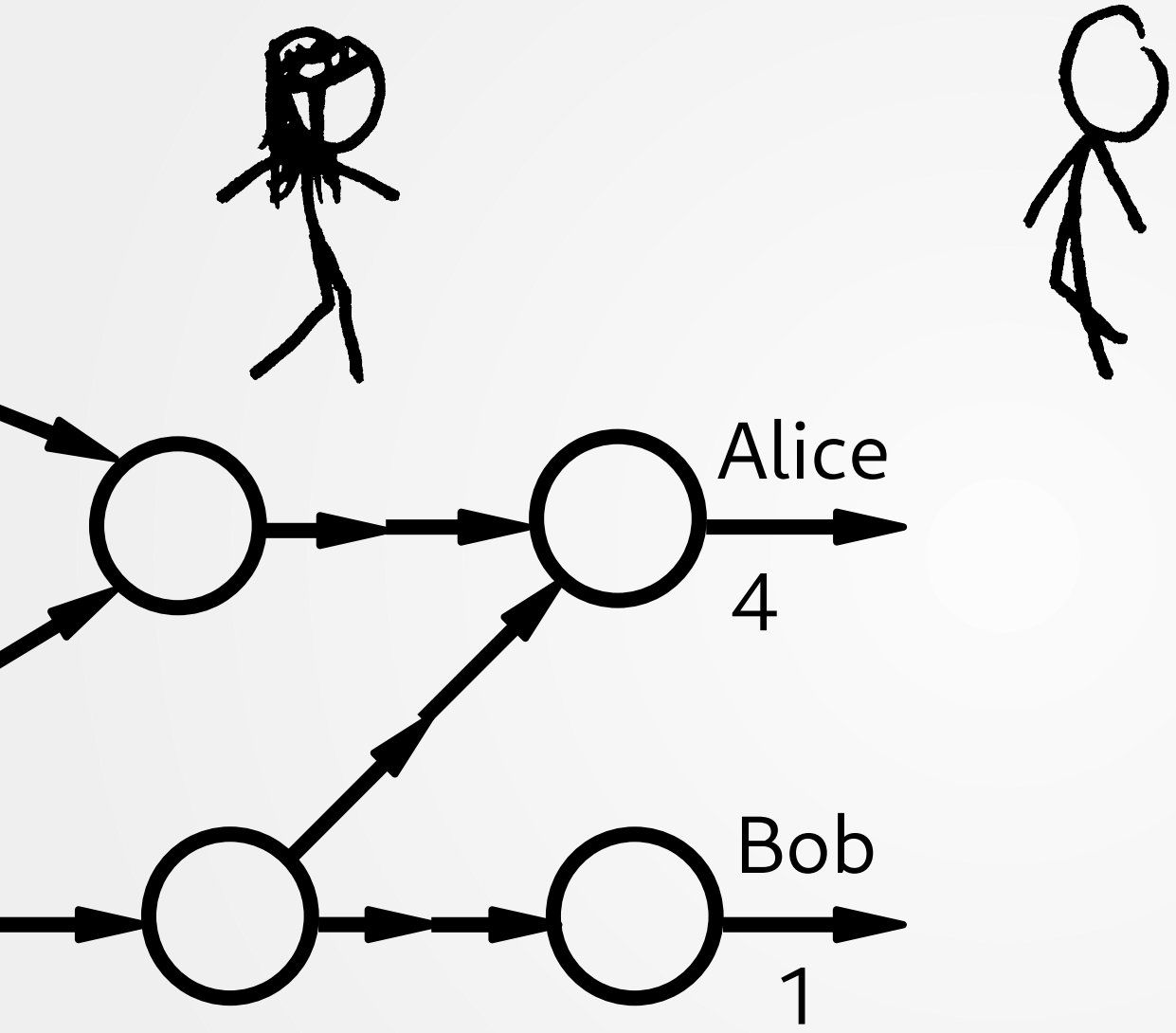
1 hour

Problem
All txs validated by all wallets

Problem
All txs validated by all wallets

Solution
- Move most txs off-chain
- Resolve disputes on-chain

Part 1
2-party channels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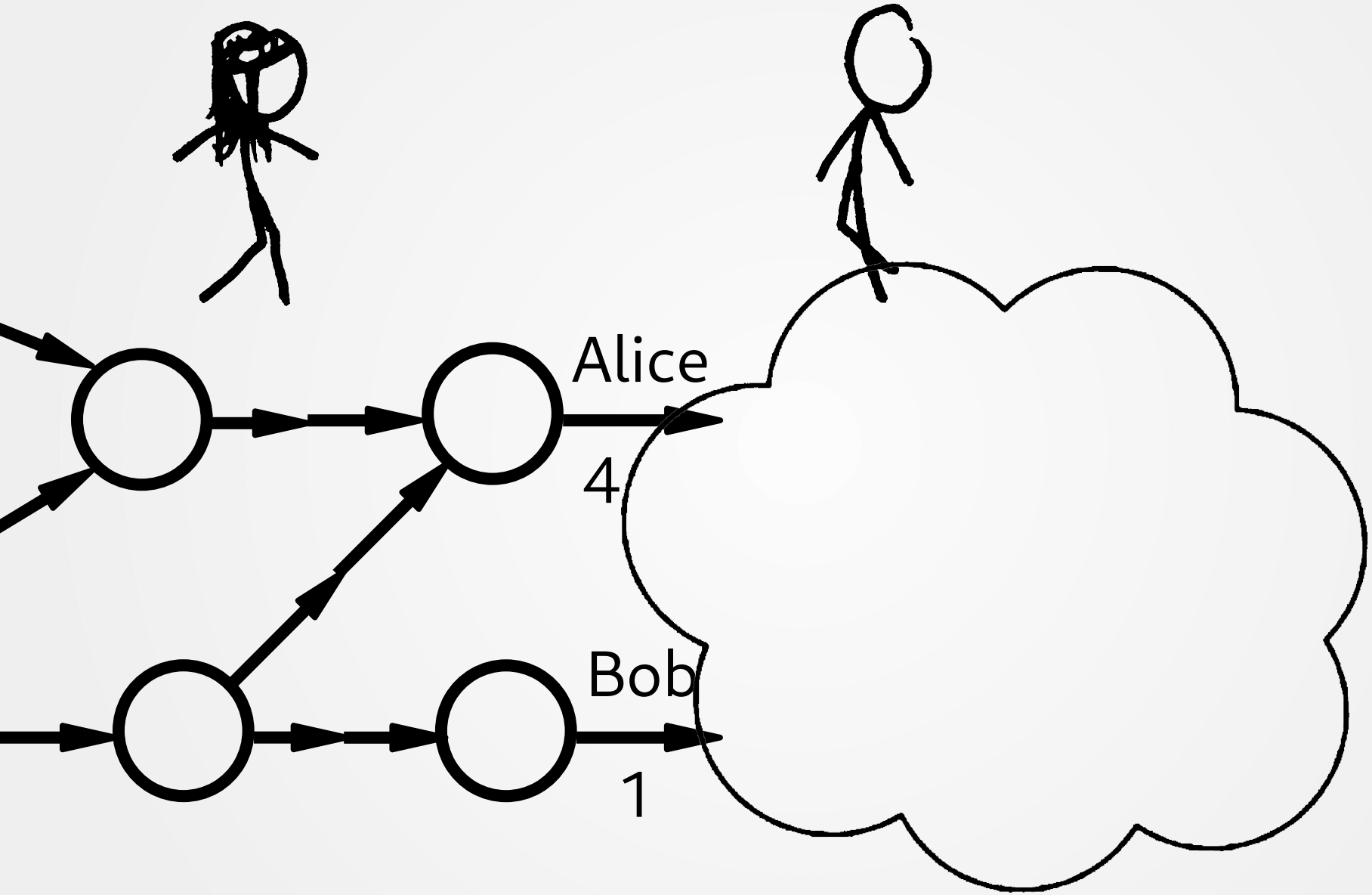
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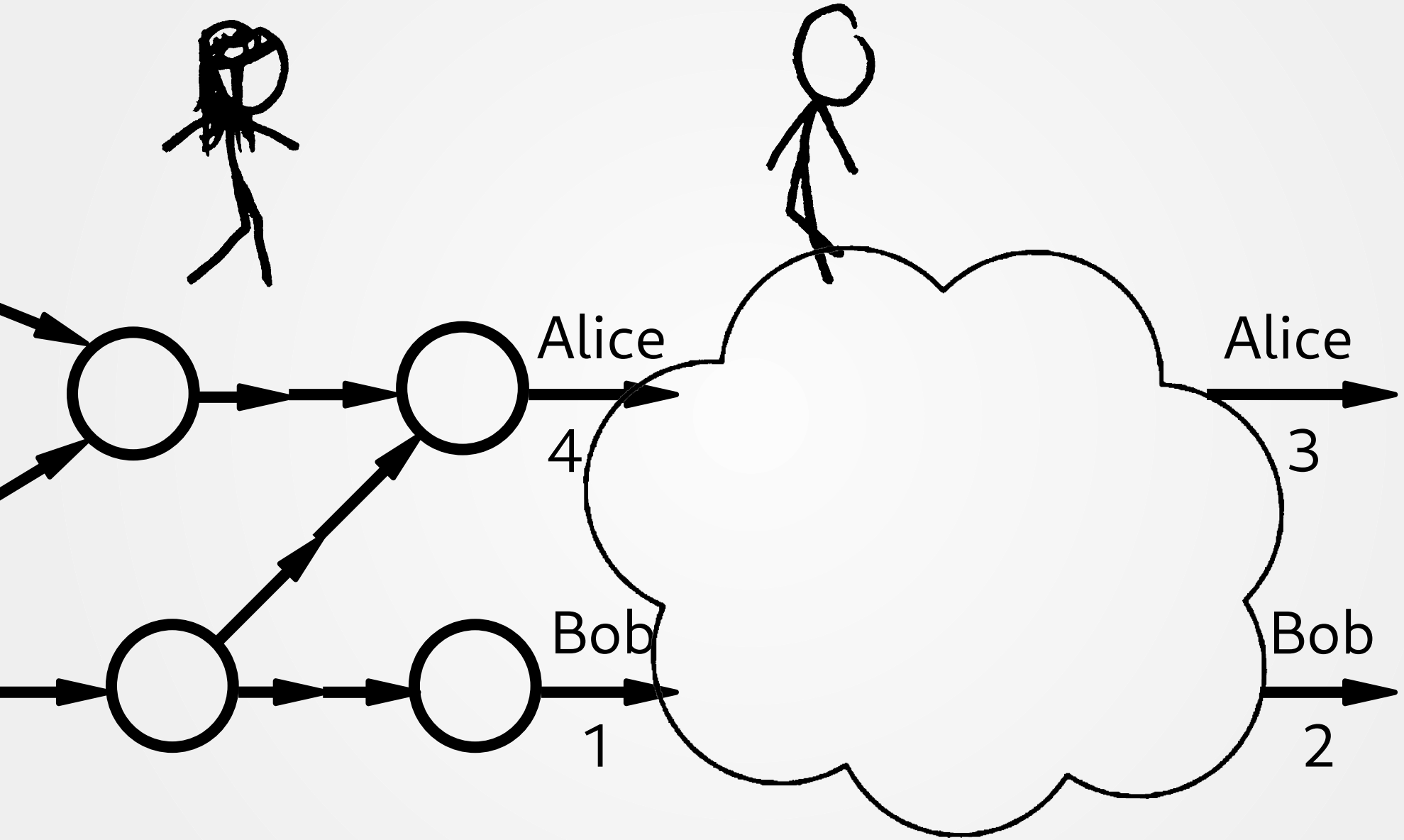
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Bob
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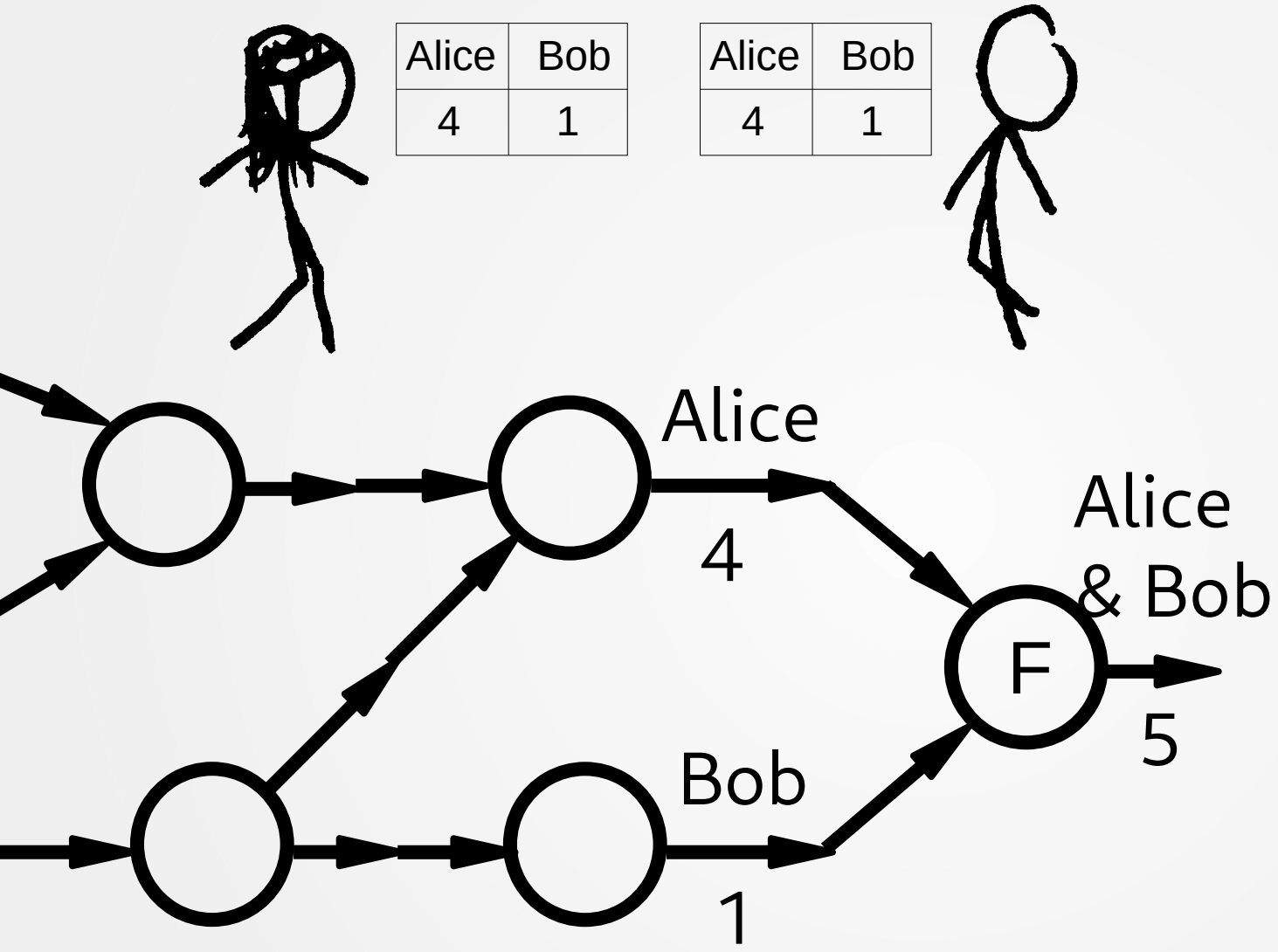
Alice
Bob
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Alice
Bob
4
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Alice
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Alice
& Bob
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Bob
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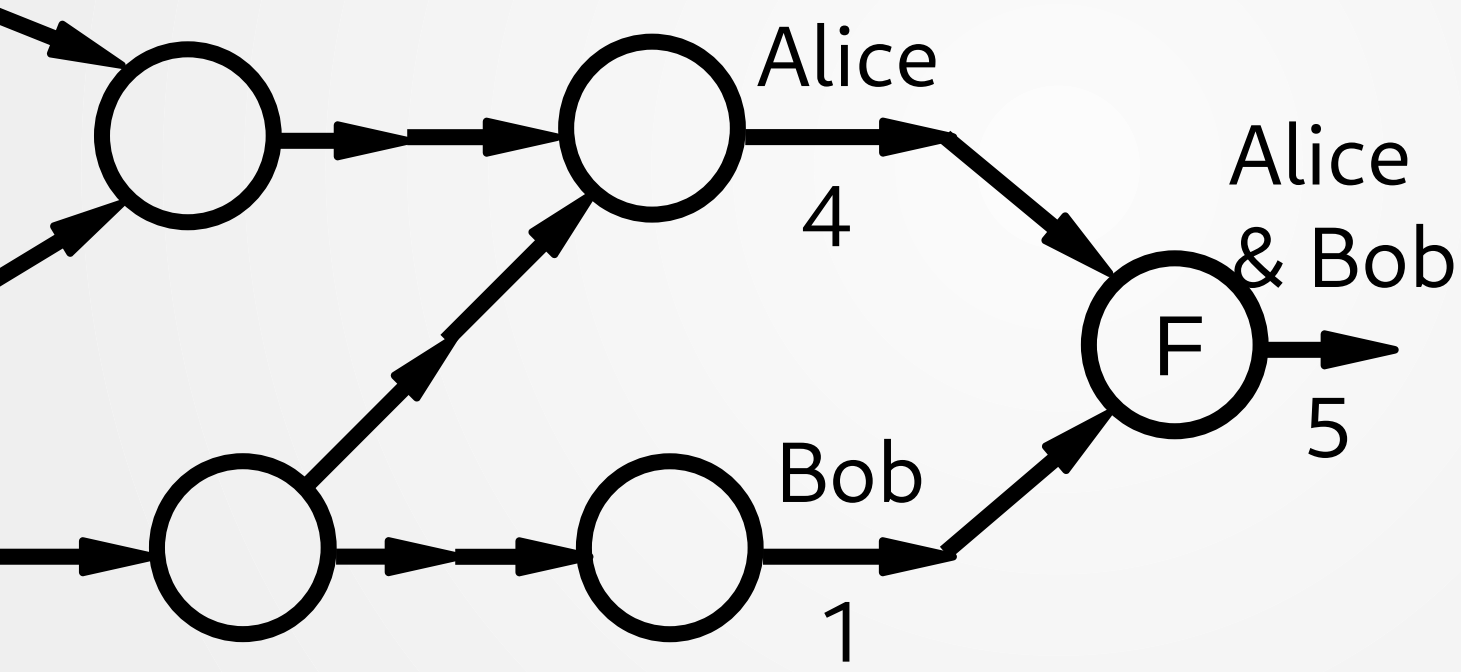
Alice	Bob
4	1
1	4

Alice	Bob
4	1
1	4



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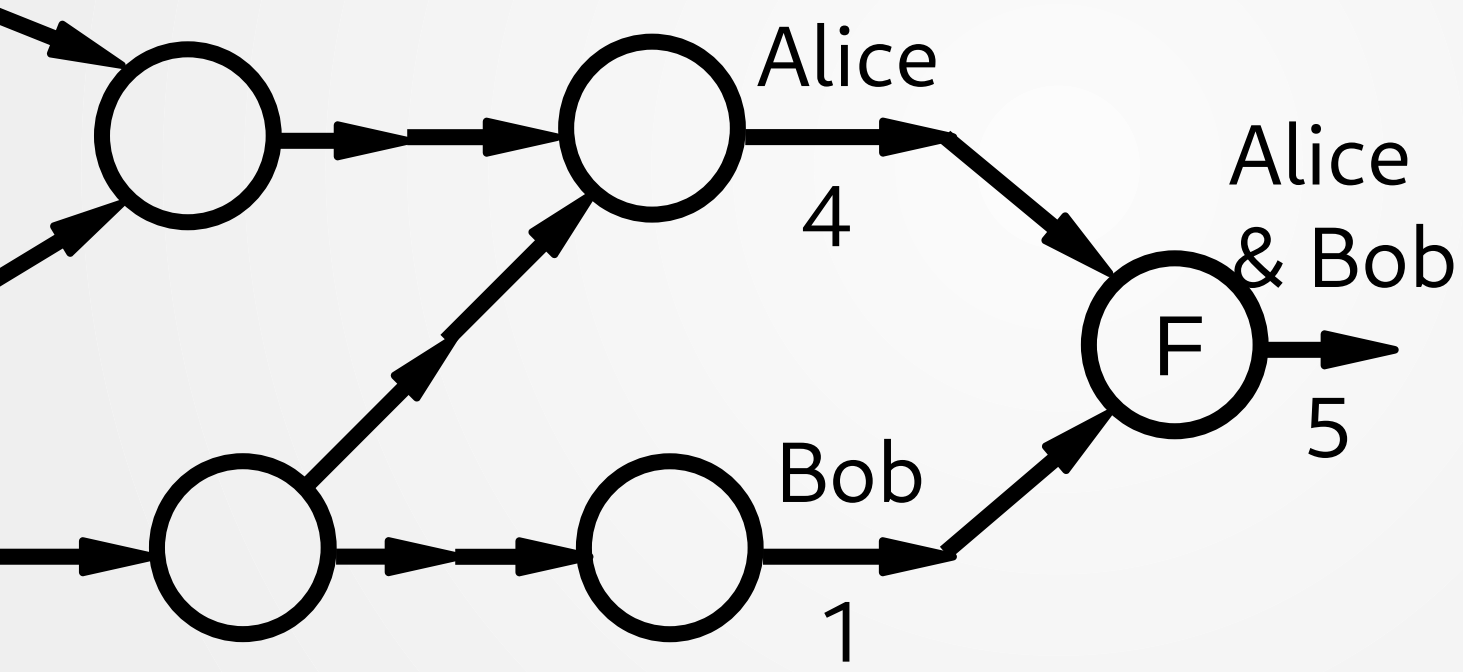
4	1
1	4
…	
3	2

Alice	Bob
4	1
1	4
…	
3	2



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…	
3	2

Alice	Bob
4	1
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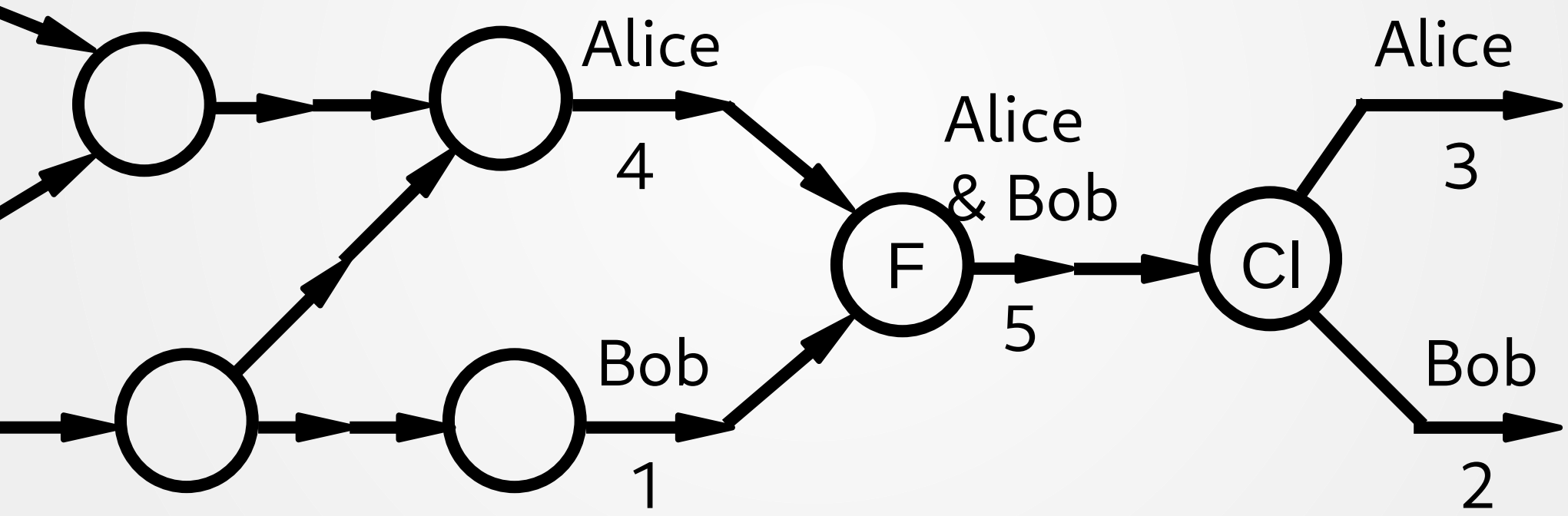
3	2



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3	2

Alice	Bob
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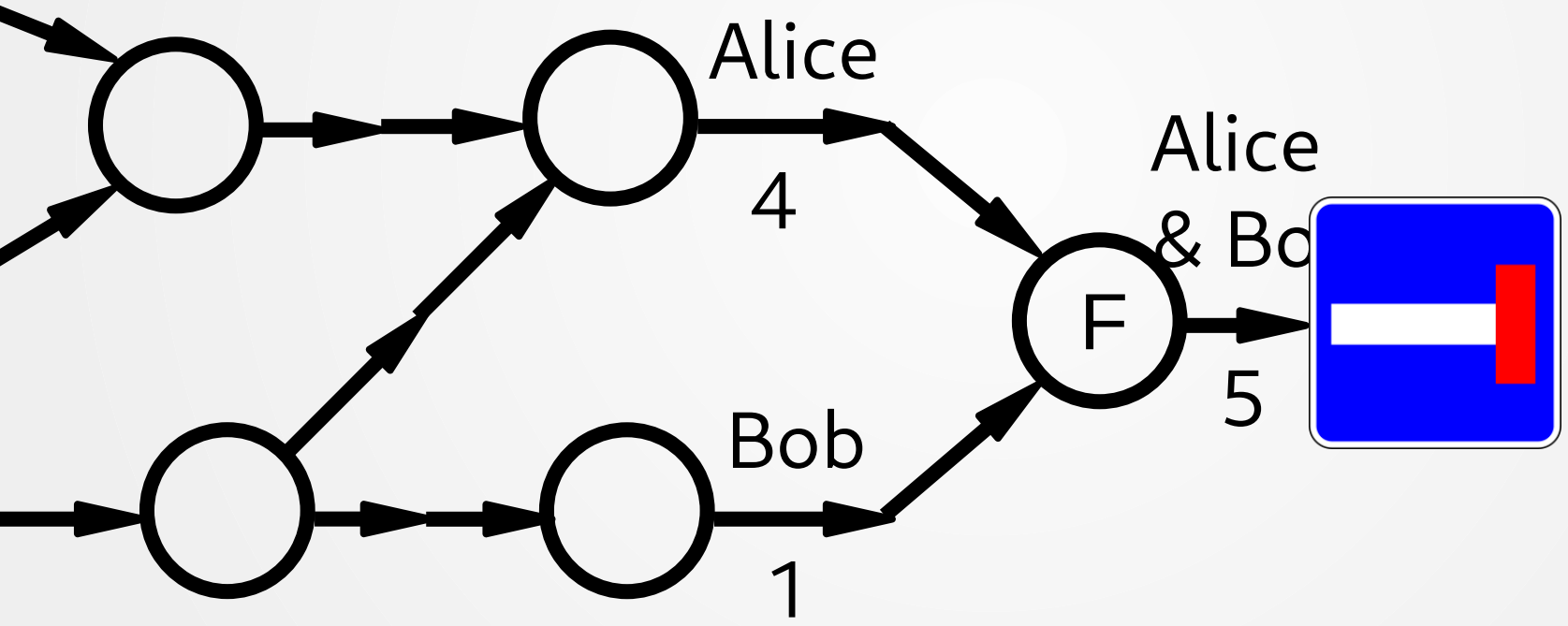

Alice

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Bob

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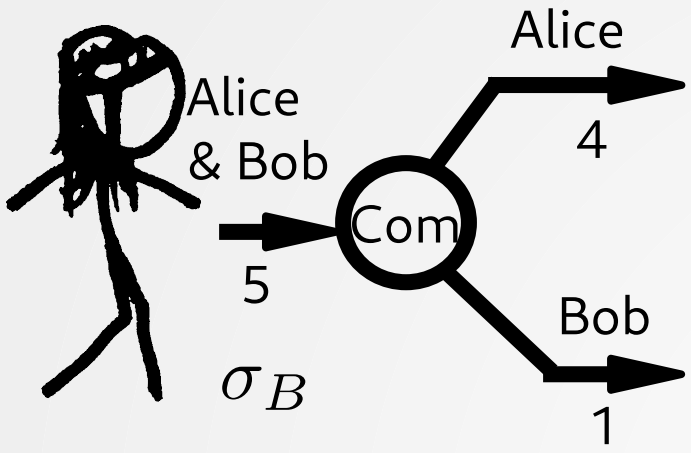
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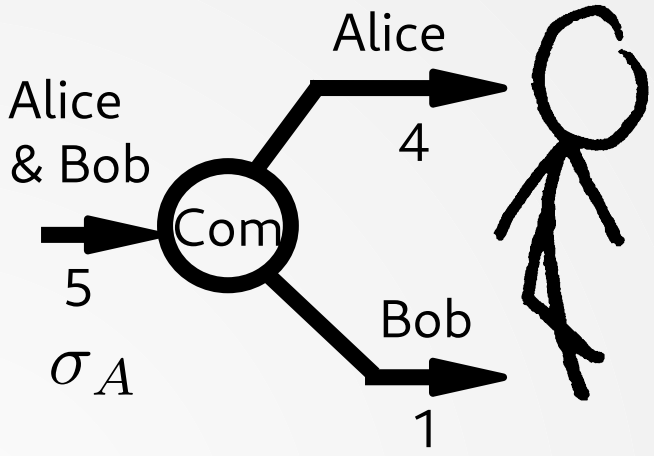
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Alice

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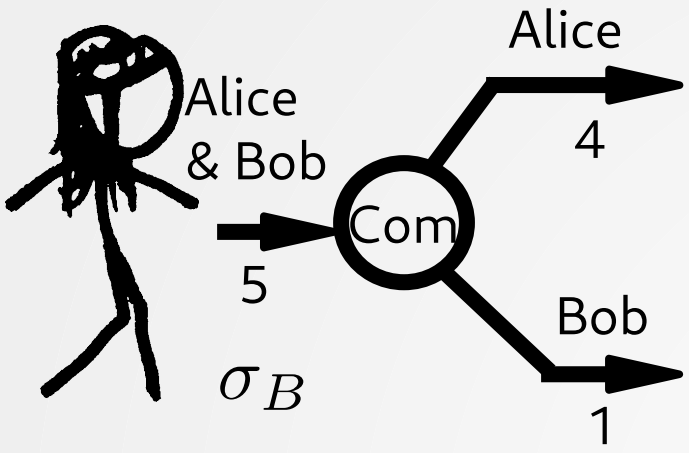
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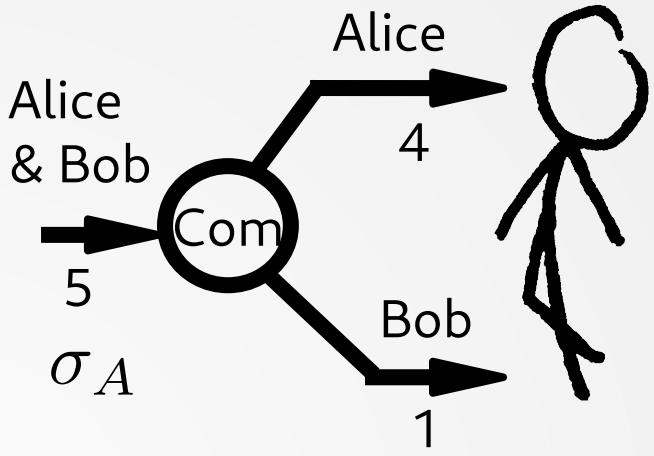
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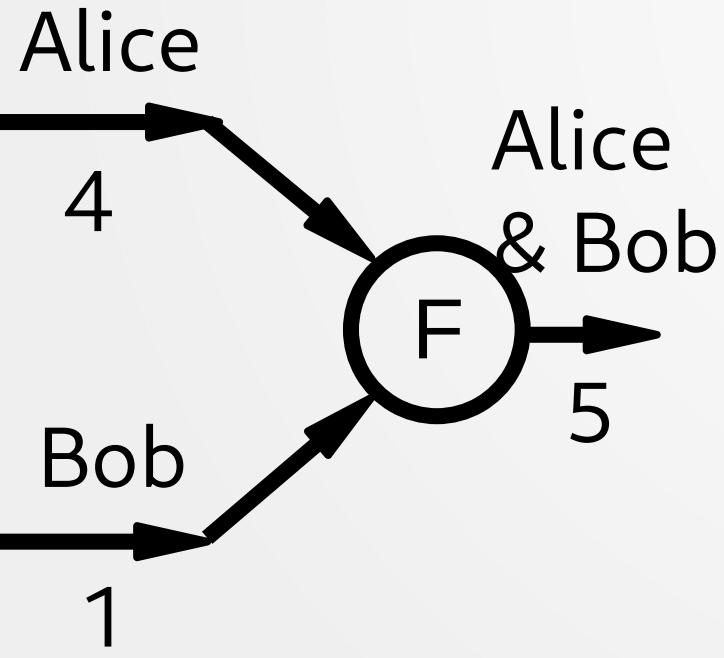
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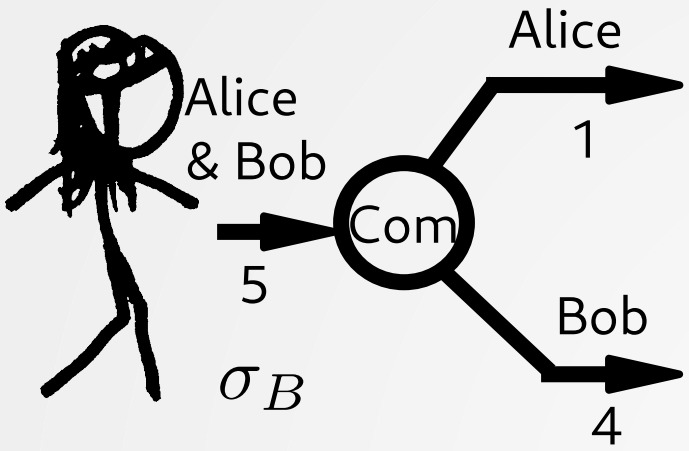
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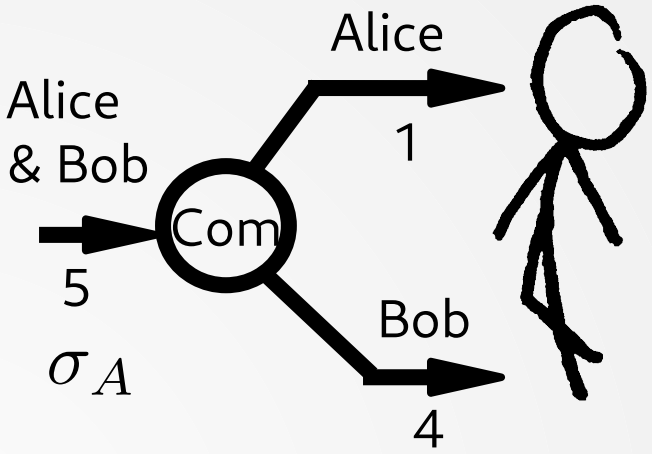
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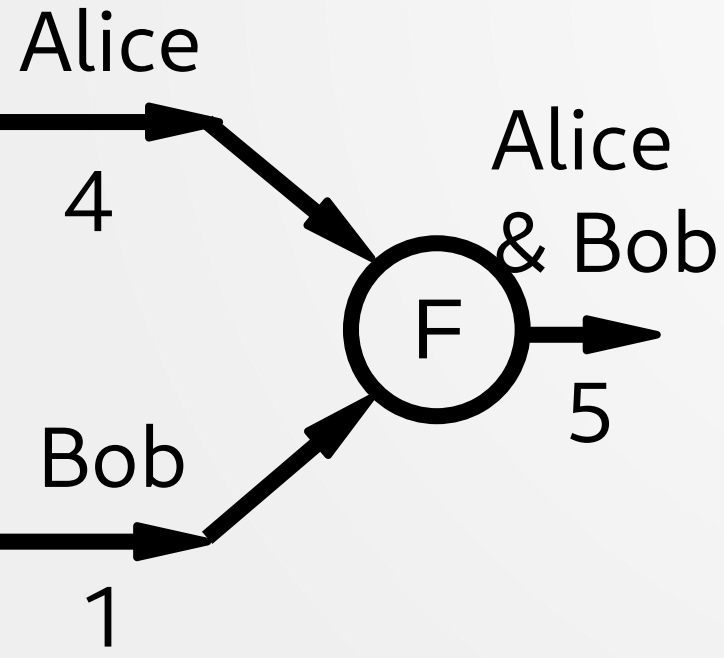
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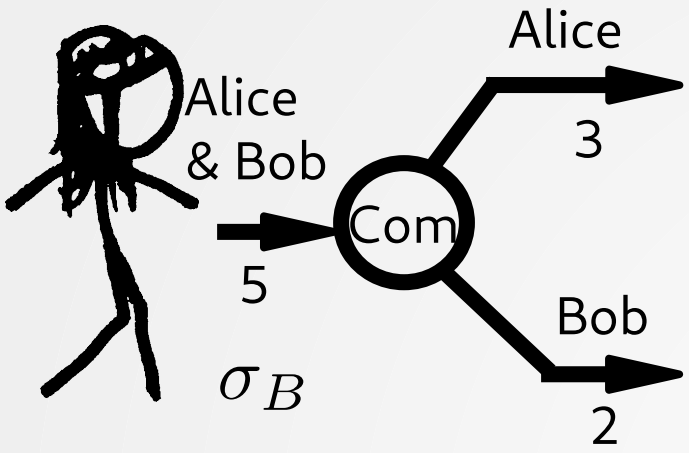
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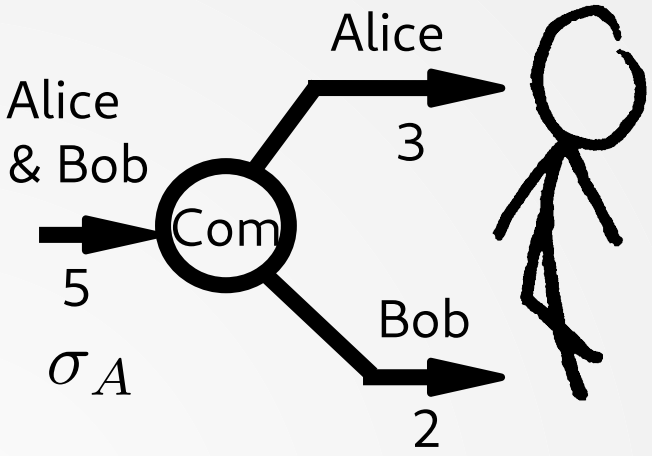
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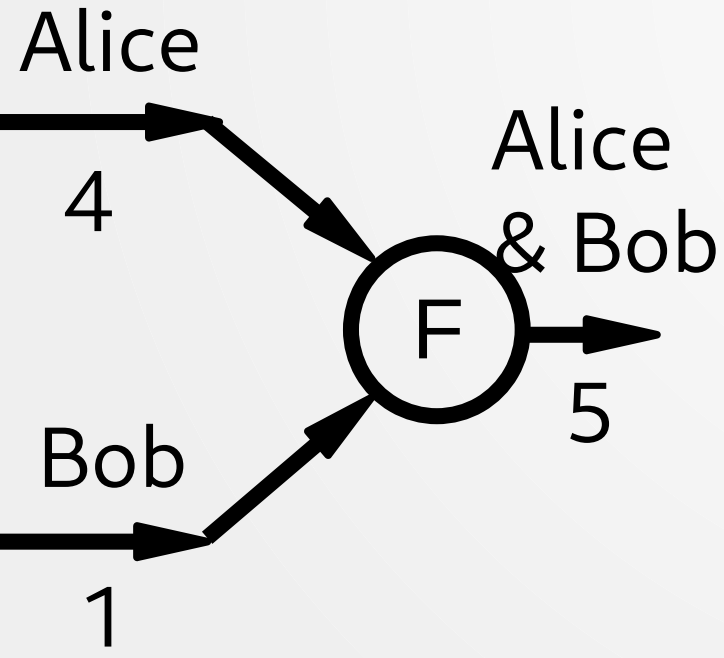
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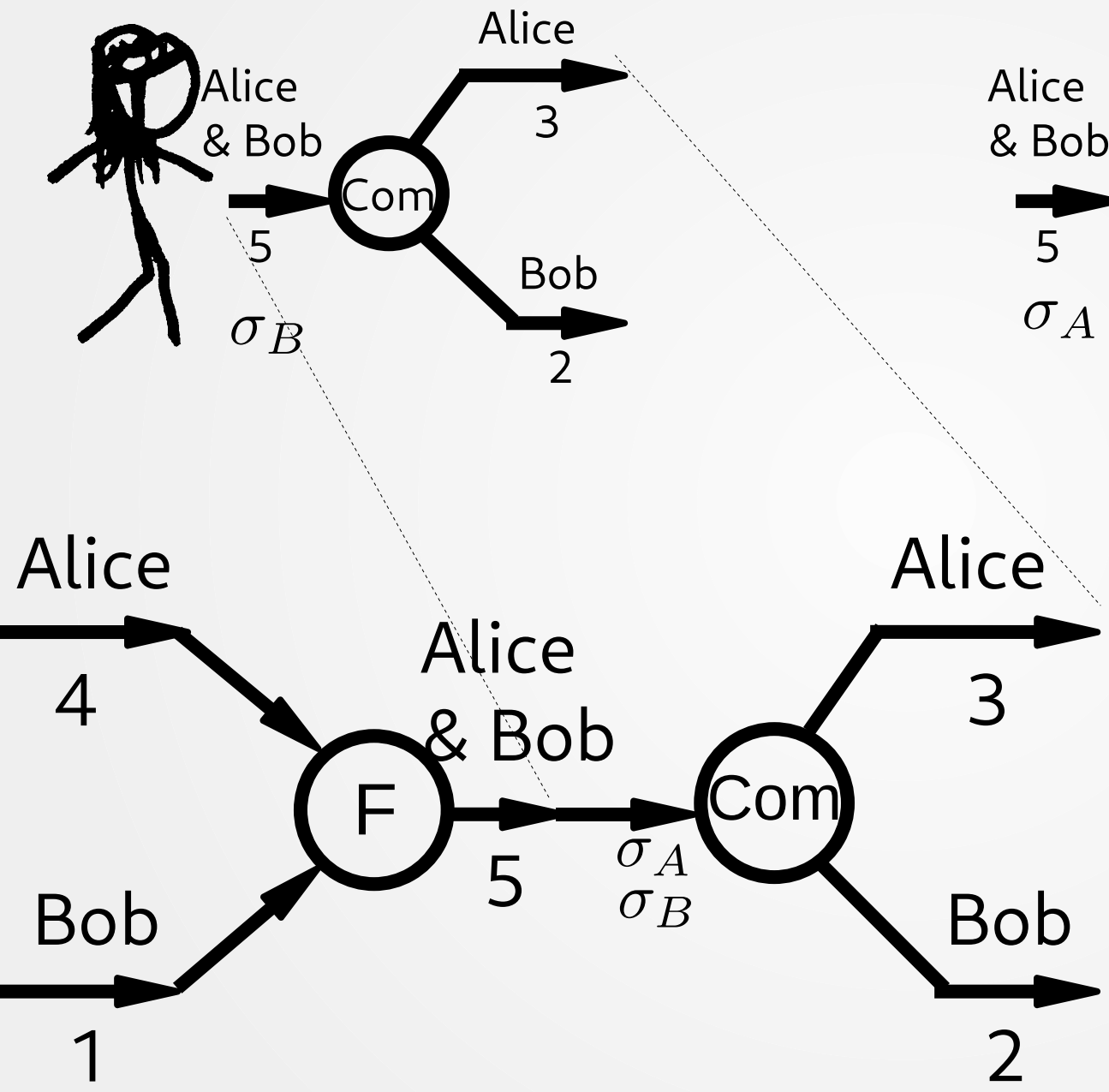
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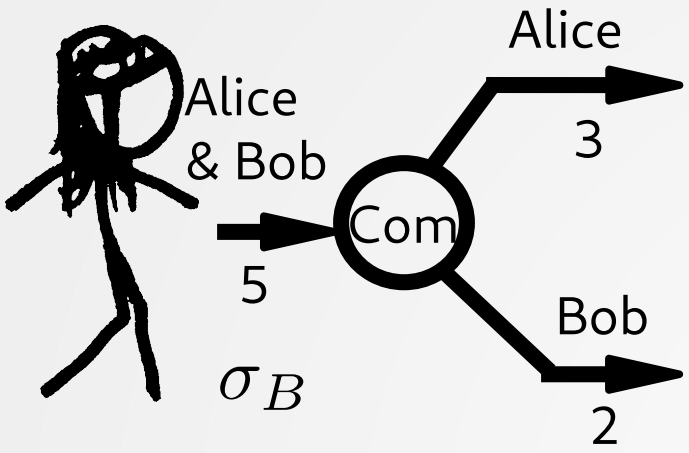
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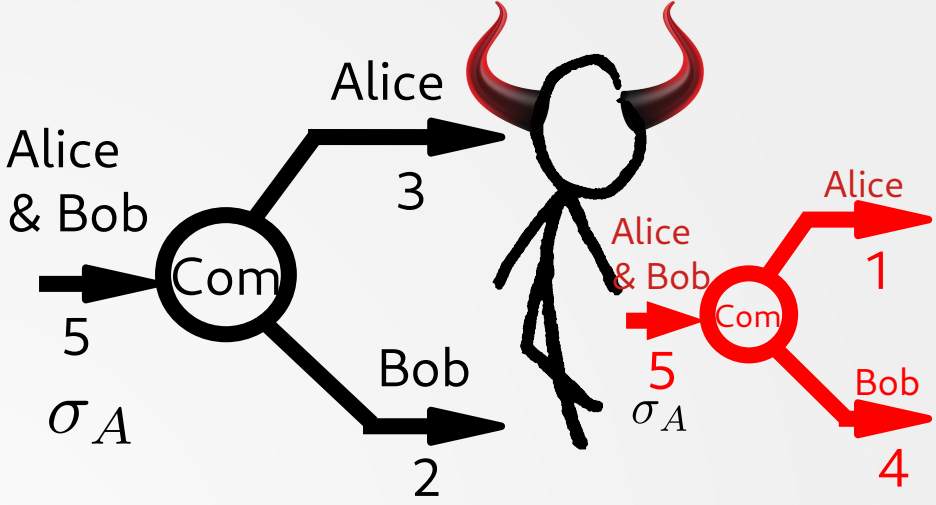
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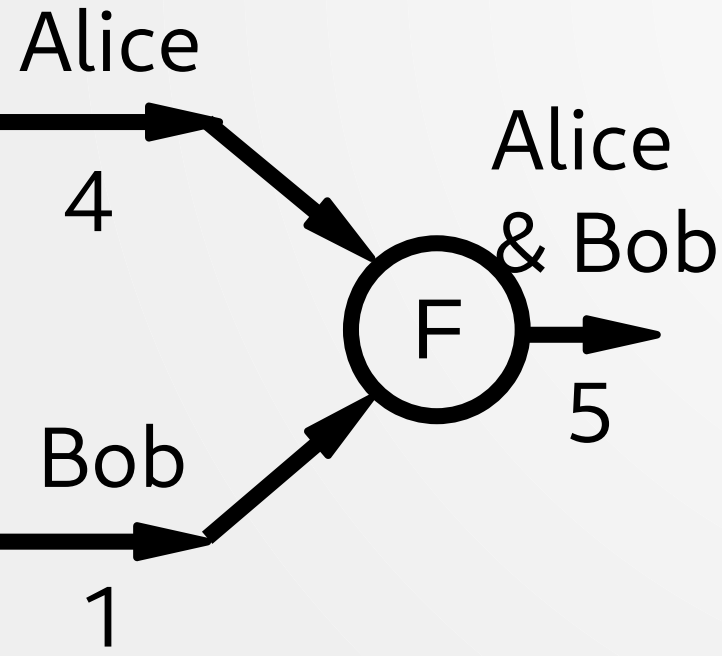
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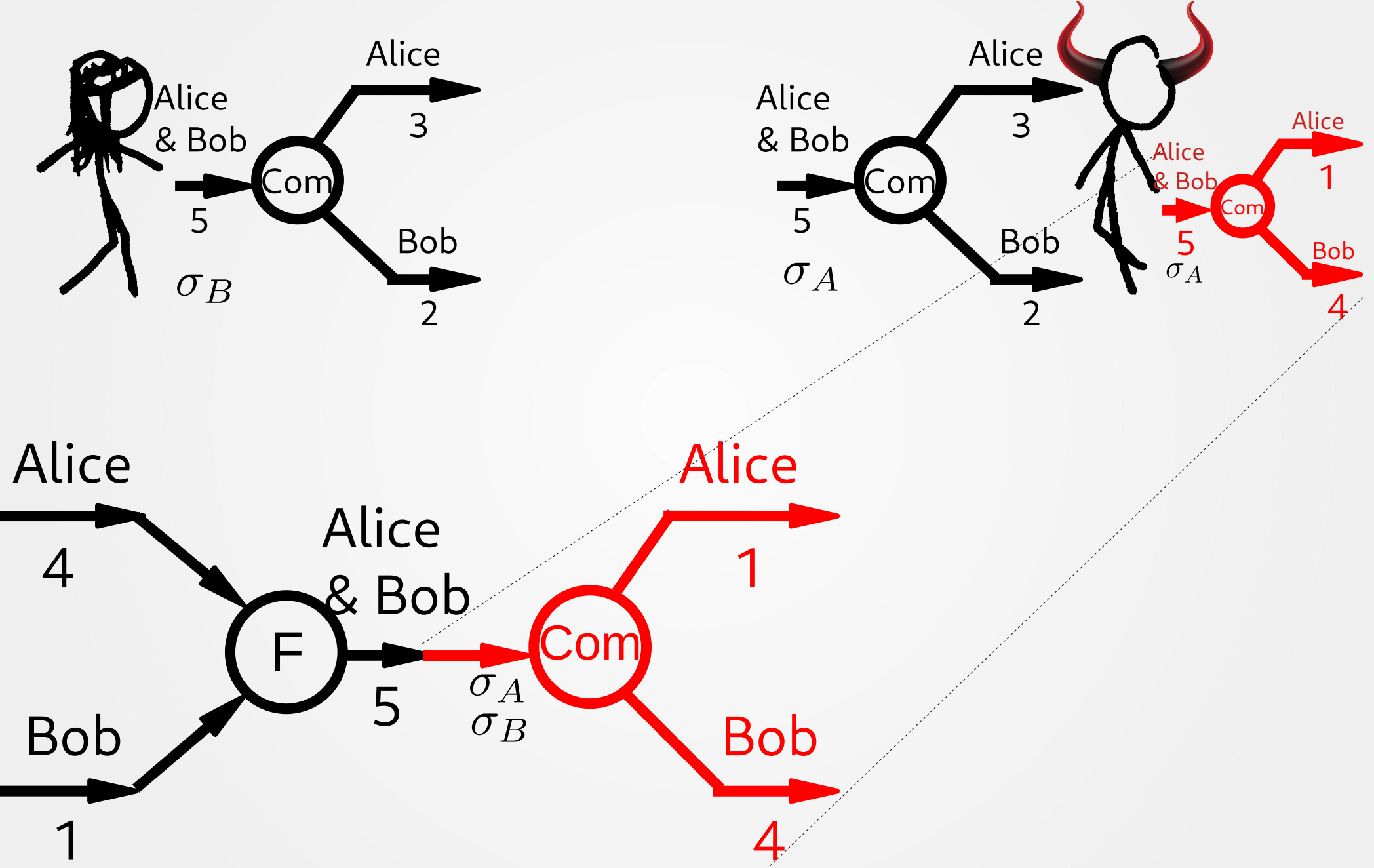
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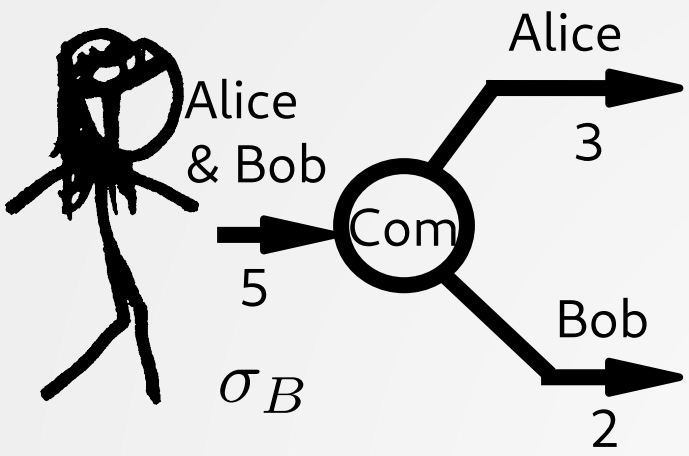

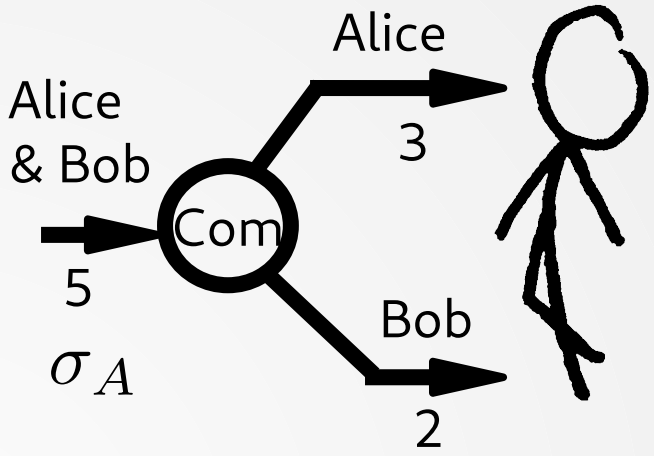

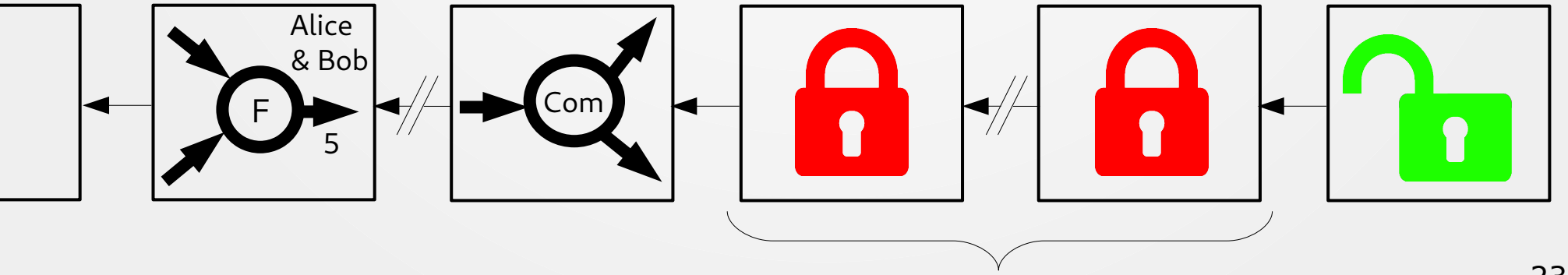

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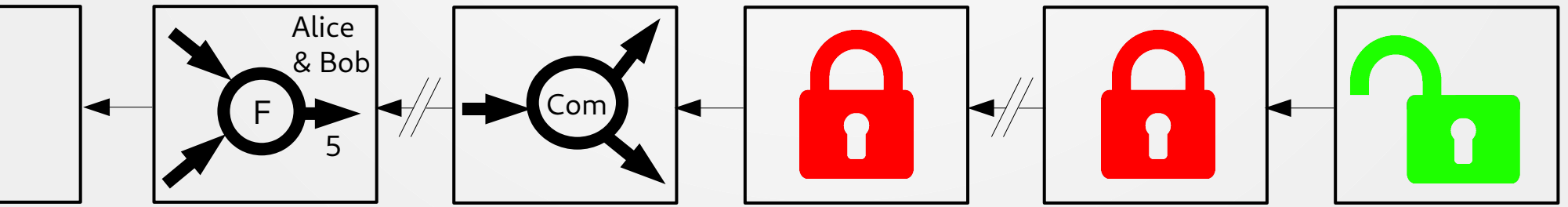

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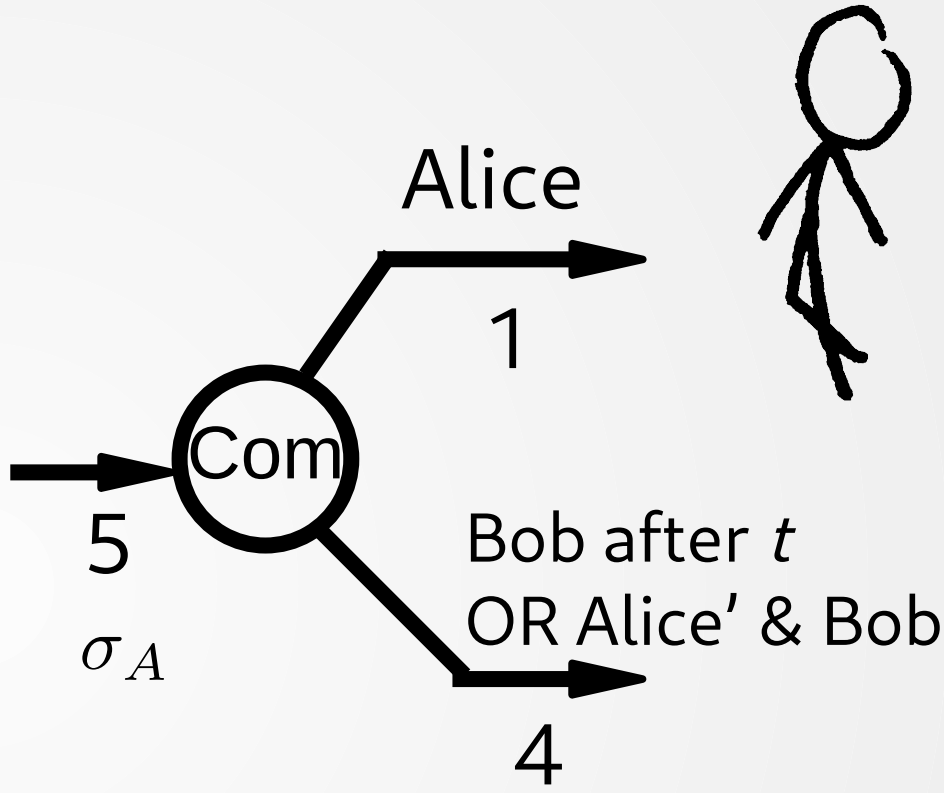
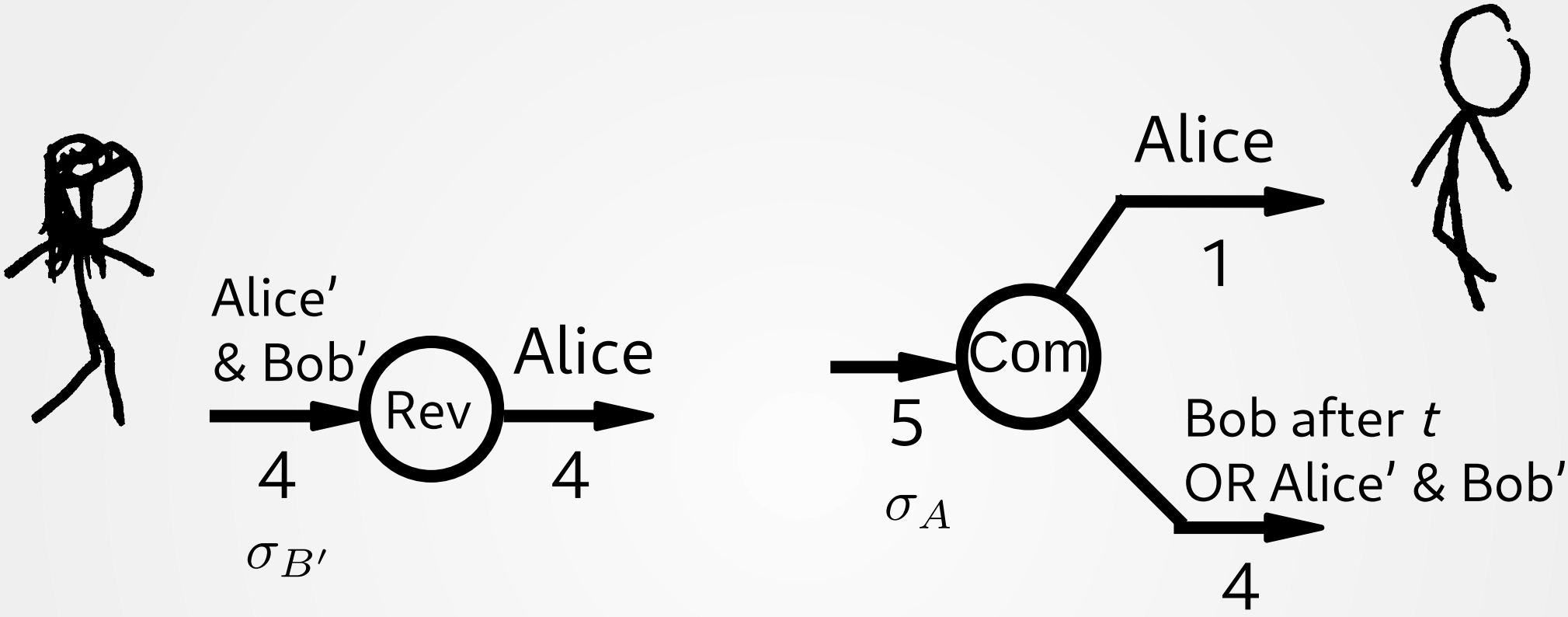
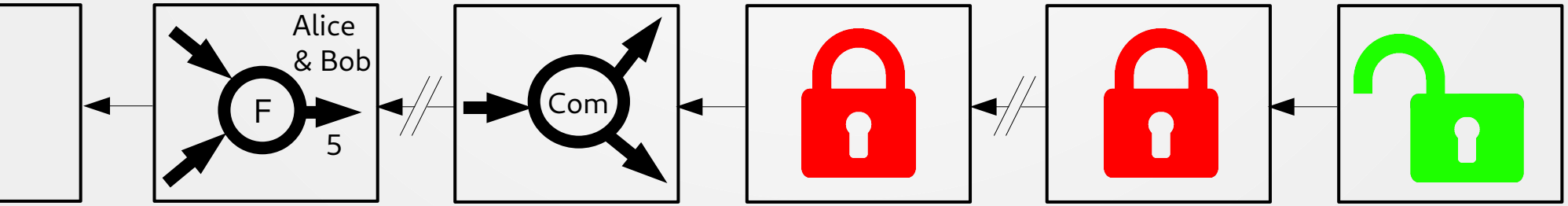






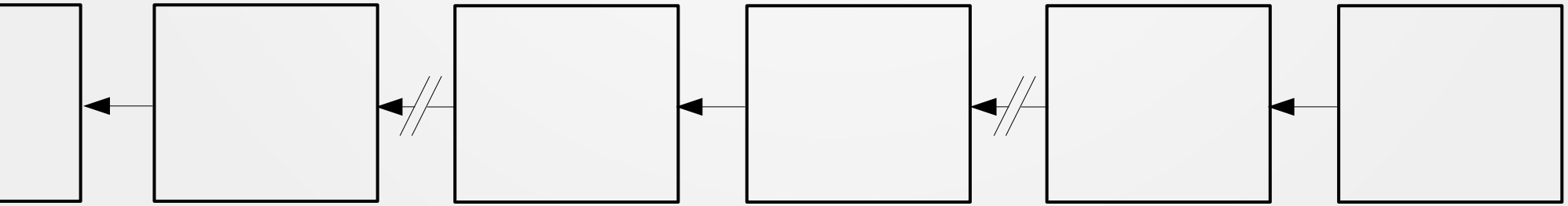
Dispute period t

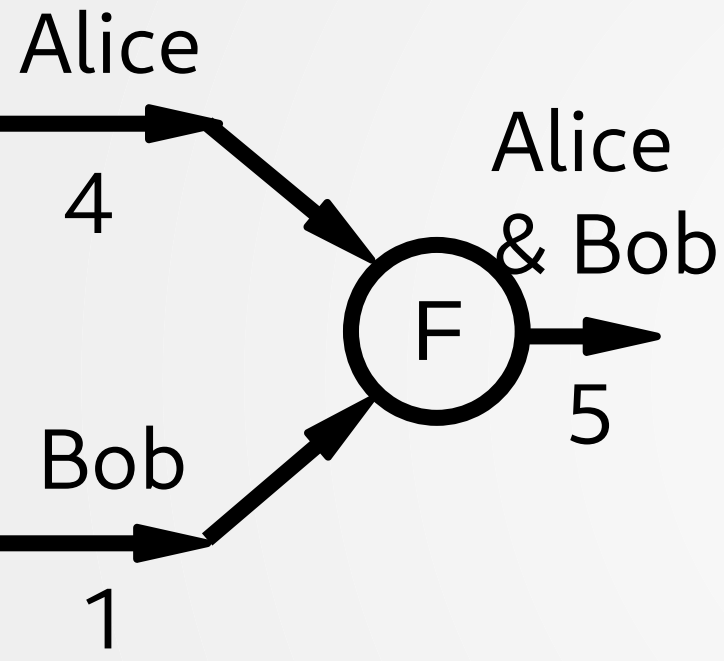
Alice

4

Bob

1




Alice
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Bob
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Alice
& Bob
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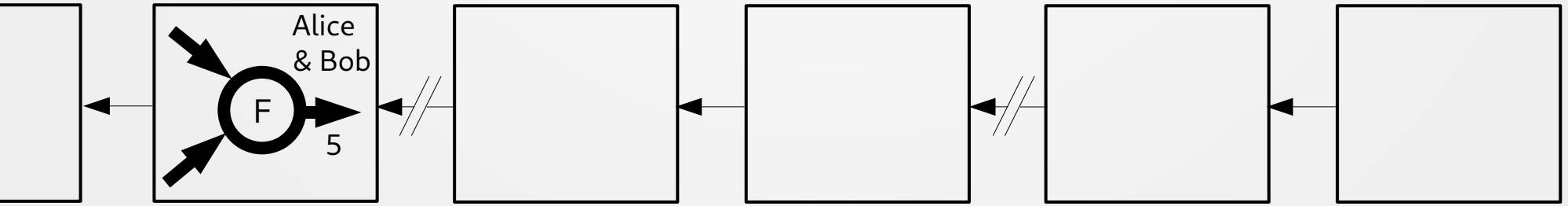
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& Bob
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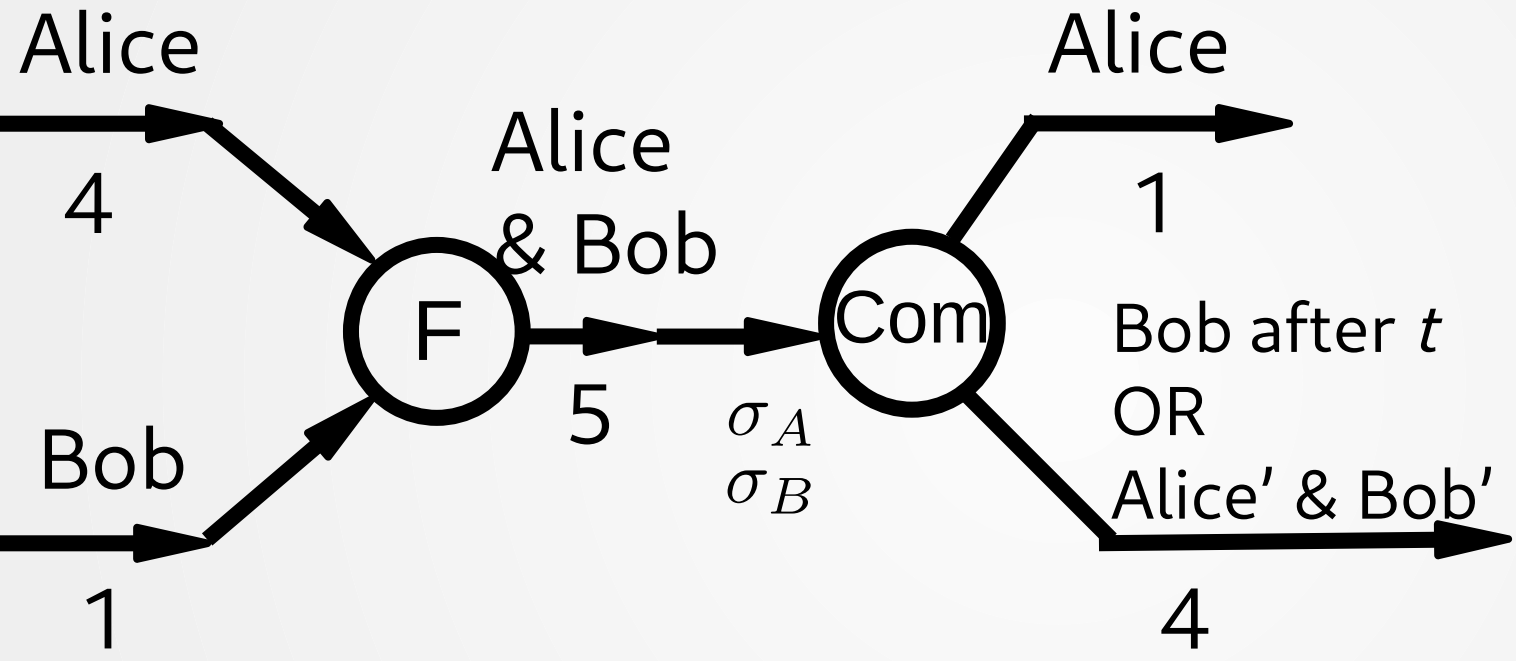

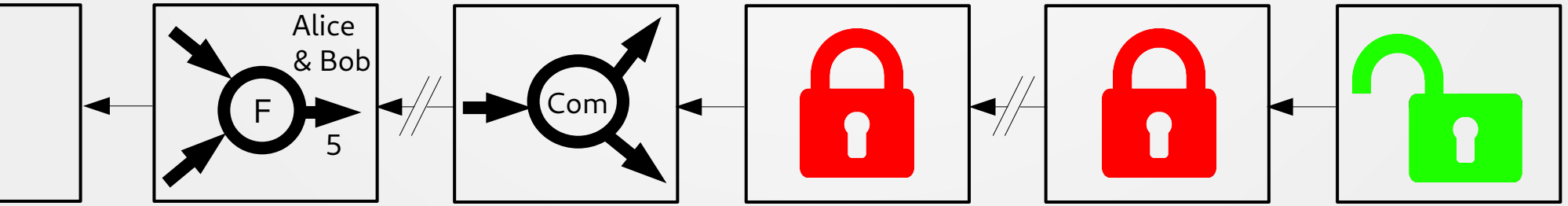

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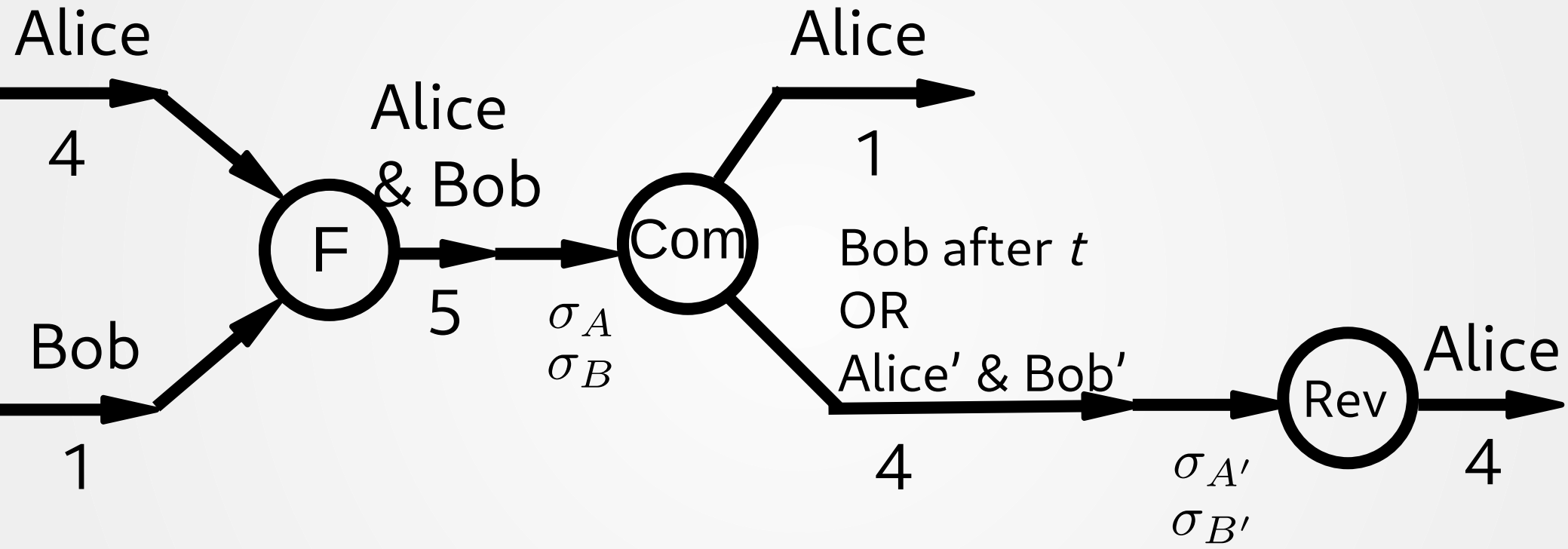

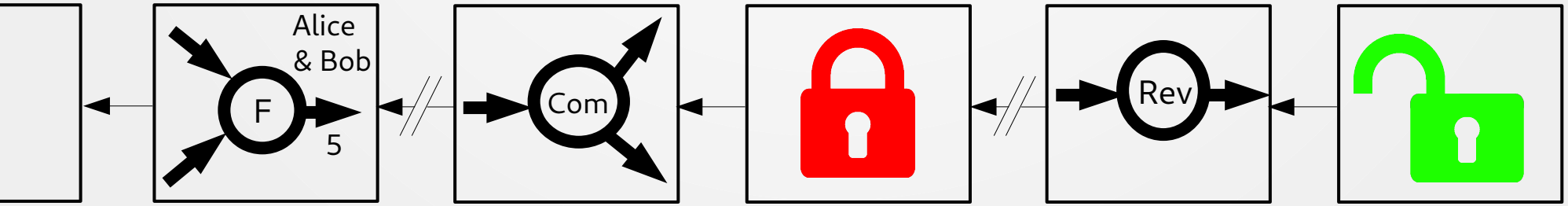

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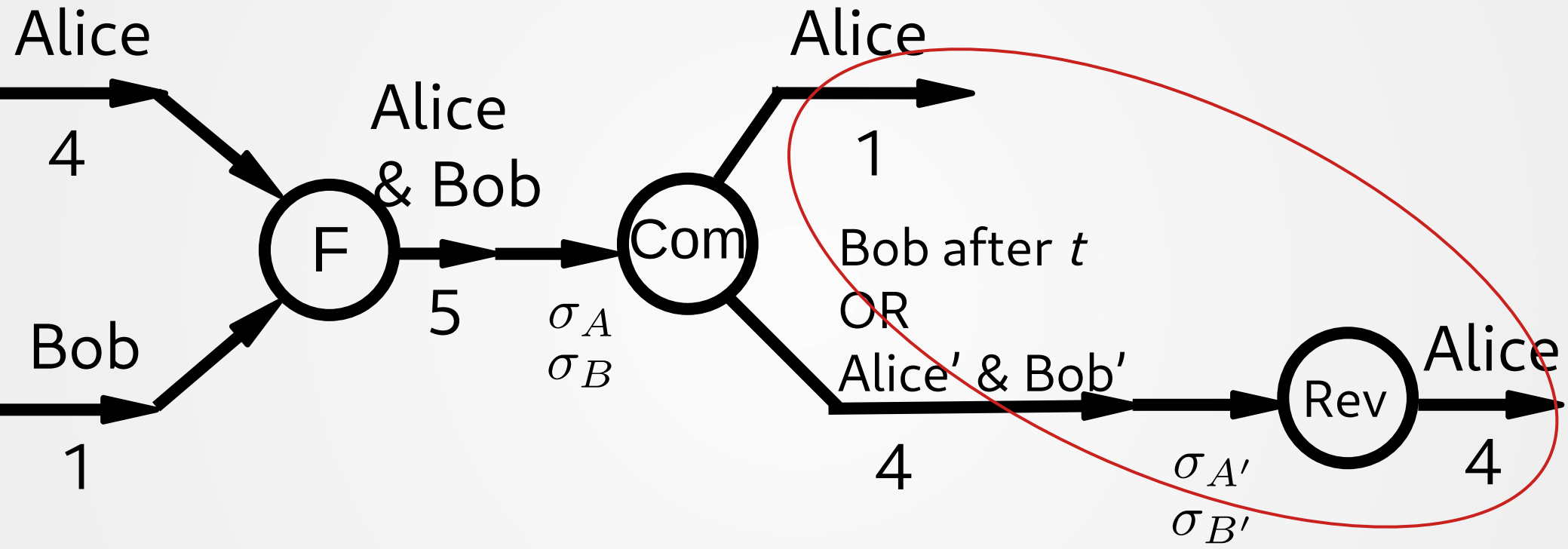

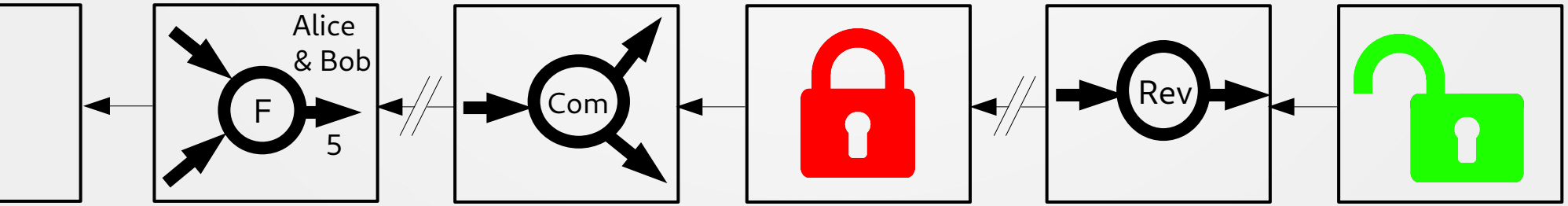

Dispute period t

Part 2
Multi-hop payments

Multi-hop payments

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Alice
Charlie
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Charlie

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Charlie
Bob
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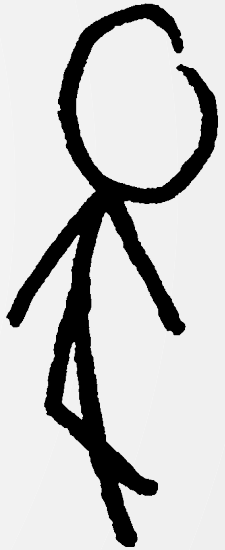
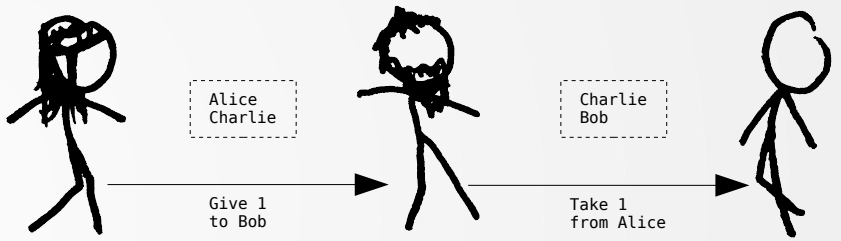


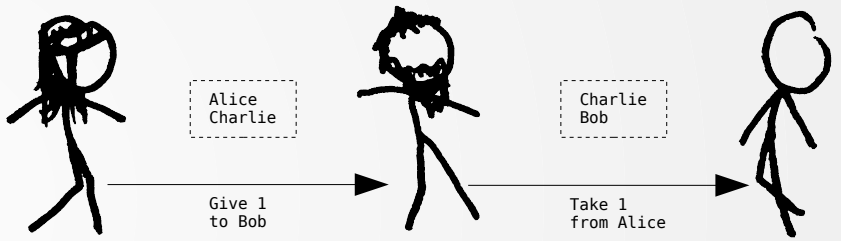
Multi-hop payments

Why no one can cheat?



Why no one can cheat?

HTLC

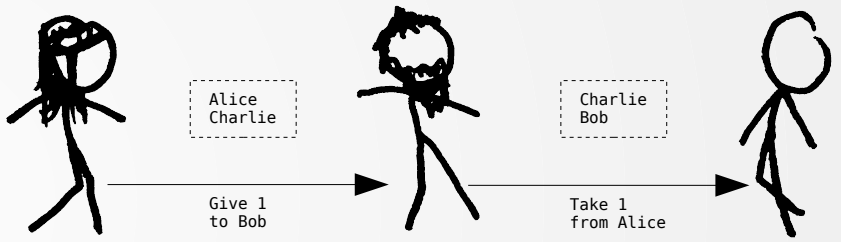


"I, Alice, promise to pay Charlie 1 coin if he reveals a preimage of **0xabcdef** within an hour"

Why no one can cheat?

HTLC

"I, Alice, promise to pay Charlie 1 coin if he reveals a preimage of `0xabcdef` within an hour"

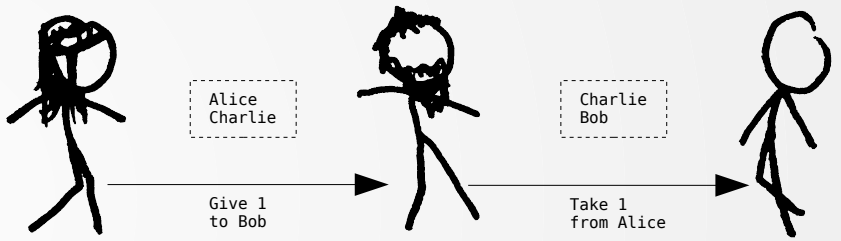


- Bob chooses random **R**, computes **h=H(R)**
- Bob sends **h** to Alice

Why no one can cheat?

HTLC

"I, Alice, promise to pay Charlie 1 coin if he reveals a preimage of `0xabcdef` within an hour"

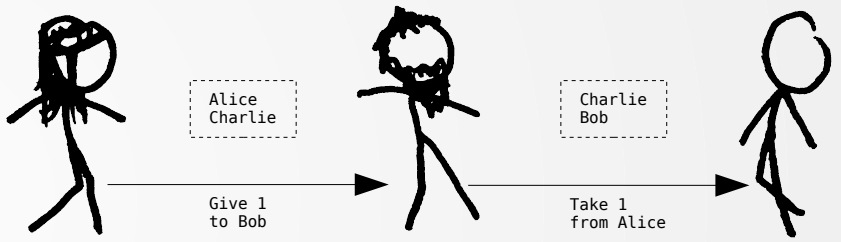


- Bob chooses random **R**, computes **h=H(R)**
- Bob sends **h** to Alice
- Alice signs an **h**-HTLC with Charlie
- Charlie signs an **h**-HTLC with Bob

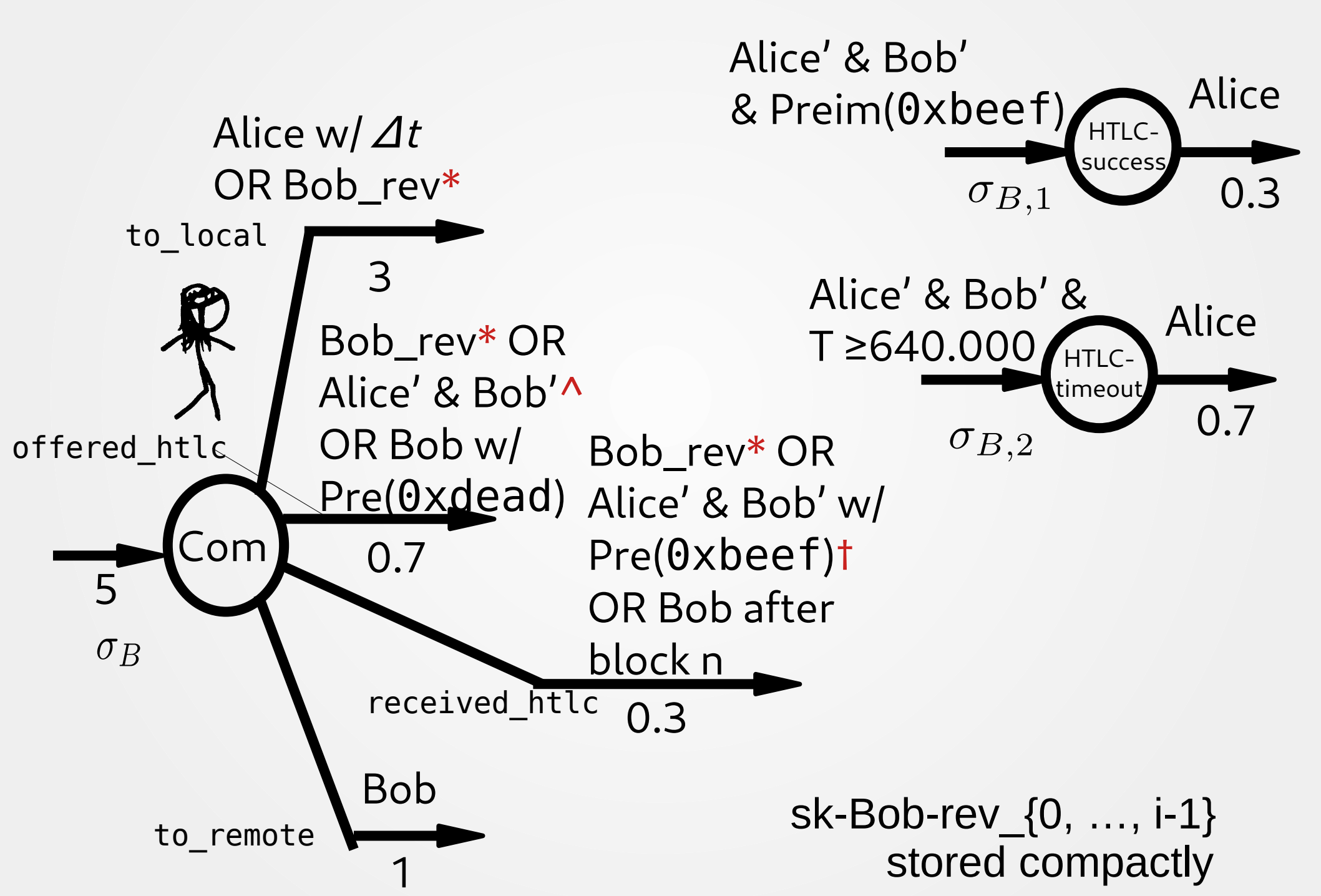
Why no one can cheat?

HTLC

"I, Alice, promise to pay Charlie 1 coin if he reveals a preimage of `0xabcdef` within an hour"



- Bob chooses random **R**, computes **h=H(R)**
- Bob sends **h** to Alice
- Alice signs an **h**-HTLC with Charlie
- Charlie signs an **h**-HTLC with Bob
- Bob reveals **R** to Charlie, gets 1
- Charlie reveals **R** to Alice, gets 1



*Revocation ^To HTLC-timeout TX †To HTLC-success TX

https://github.com/lightningnetwork/lightning-rfc/

Thank you!