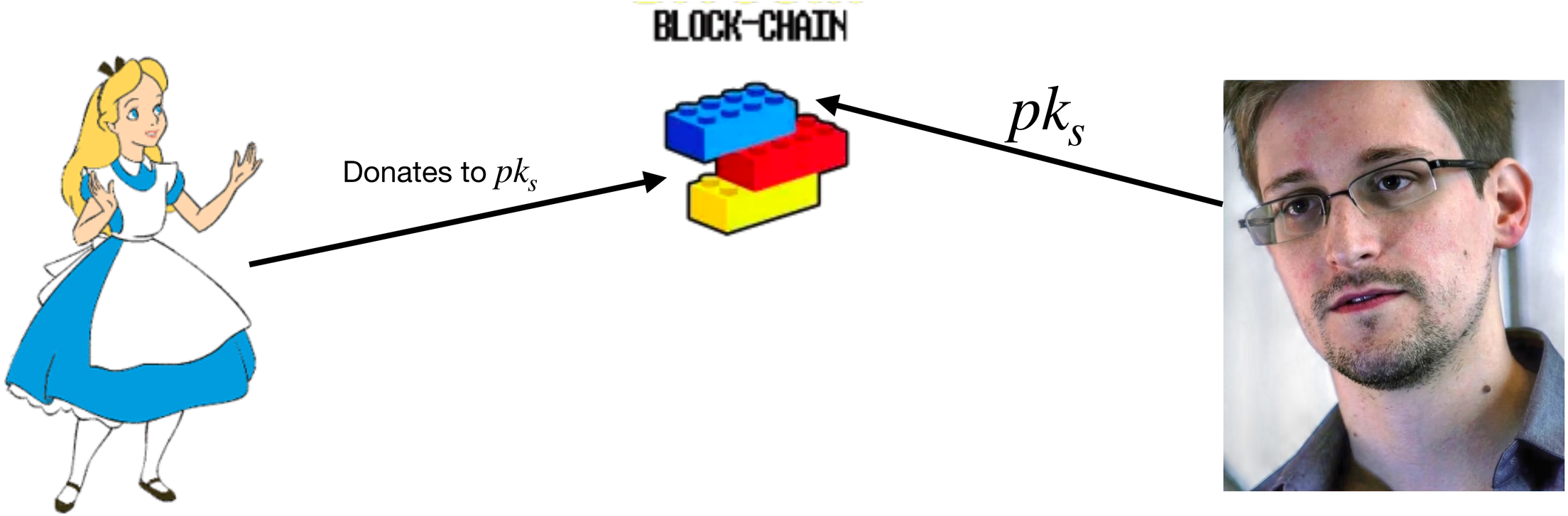
PPS:
Privacy preserving Signalling

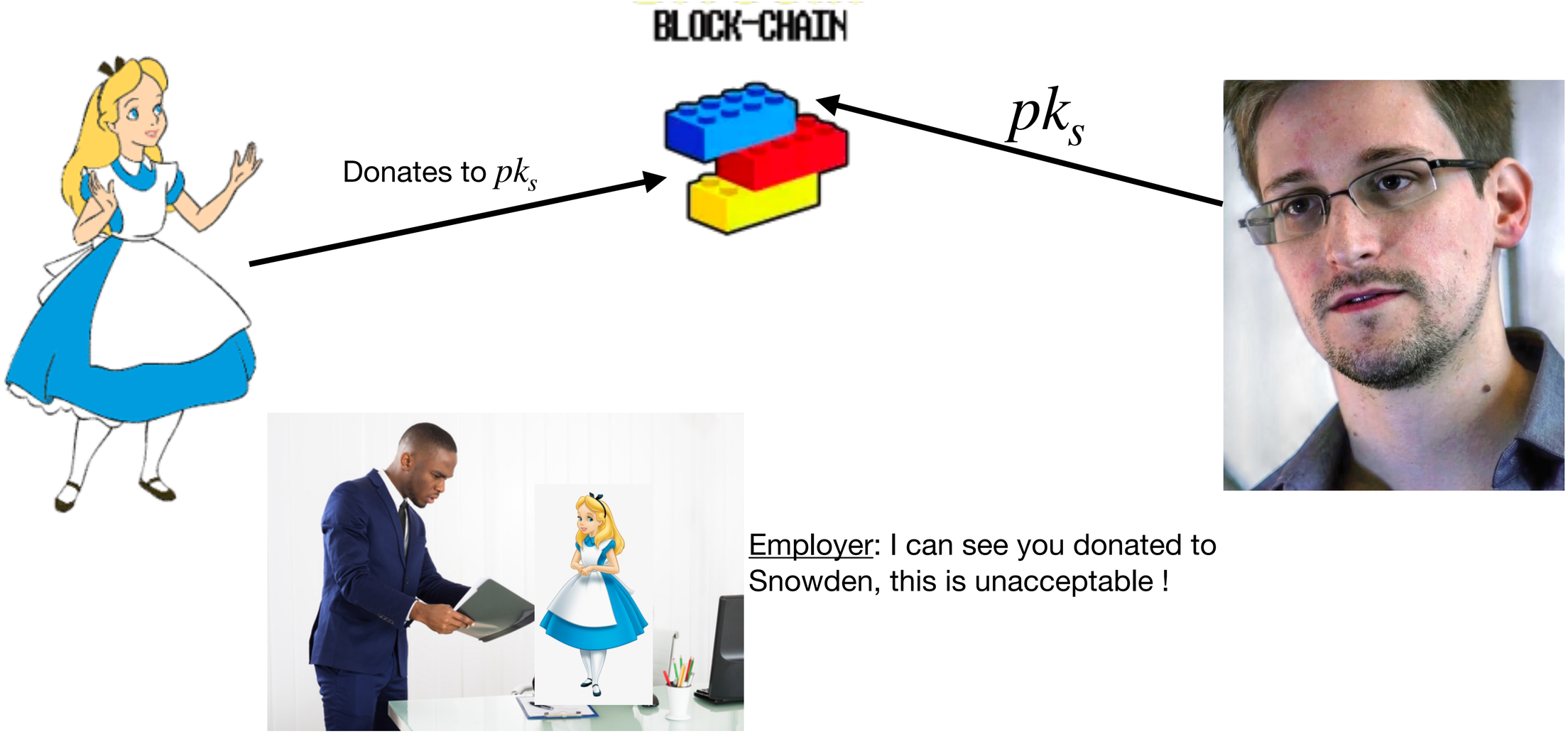
FE Hackathon 2021

Team ZenGo X

The canonical example: anonymous donations



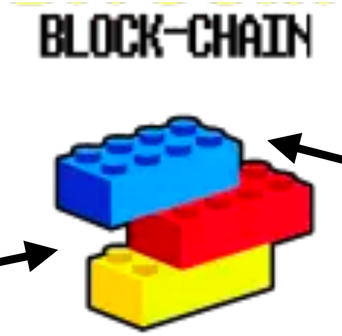
The canonical example: anonymous donations



Ideally…

Donates to

pk_{random}



pk_s

Security guarantee:
1) anonymity
2) plausible deniability

Ideally…

Donates to

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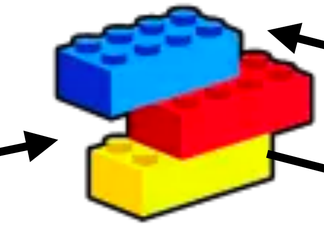
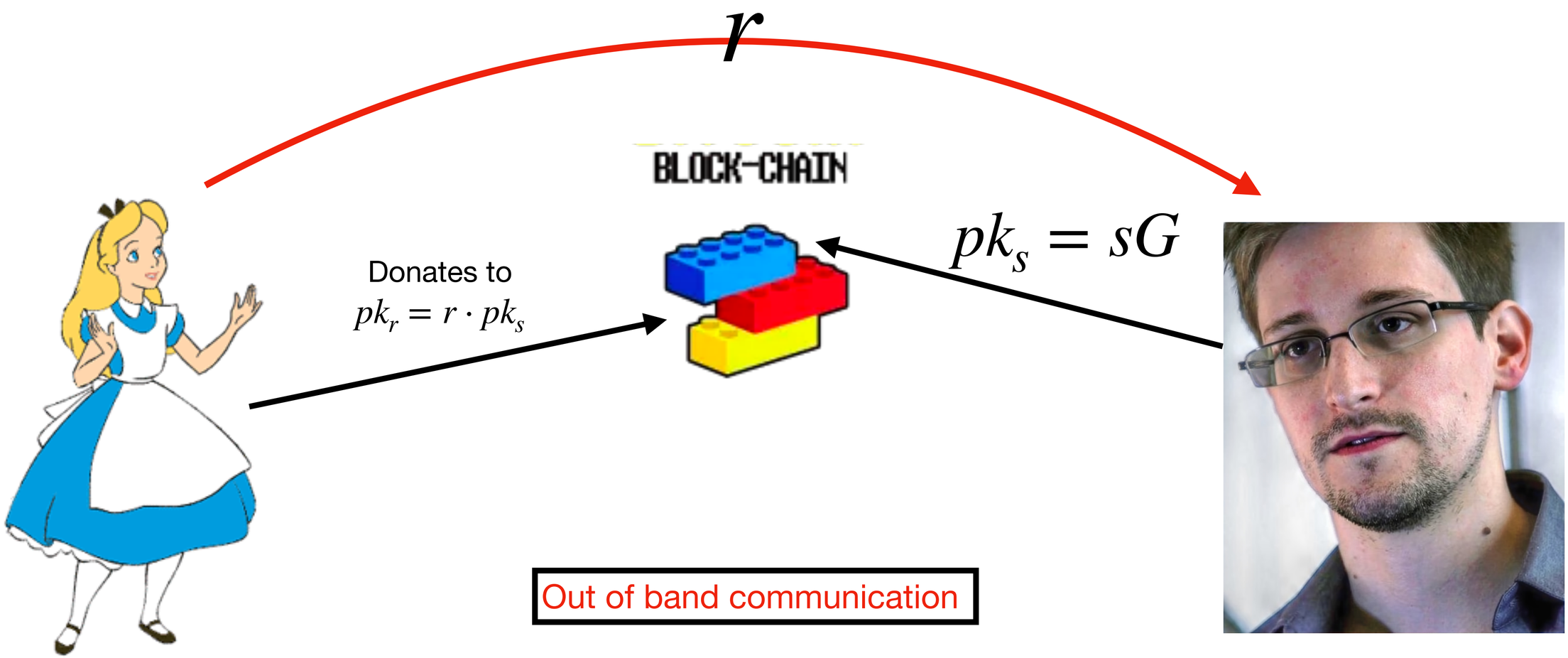


pk_s

1. Goes online
2. Detects donation

Search time < linear in number of blocks

Best solution today :



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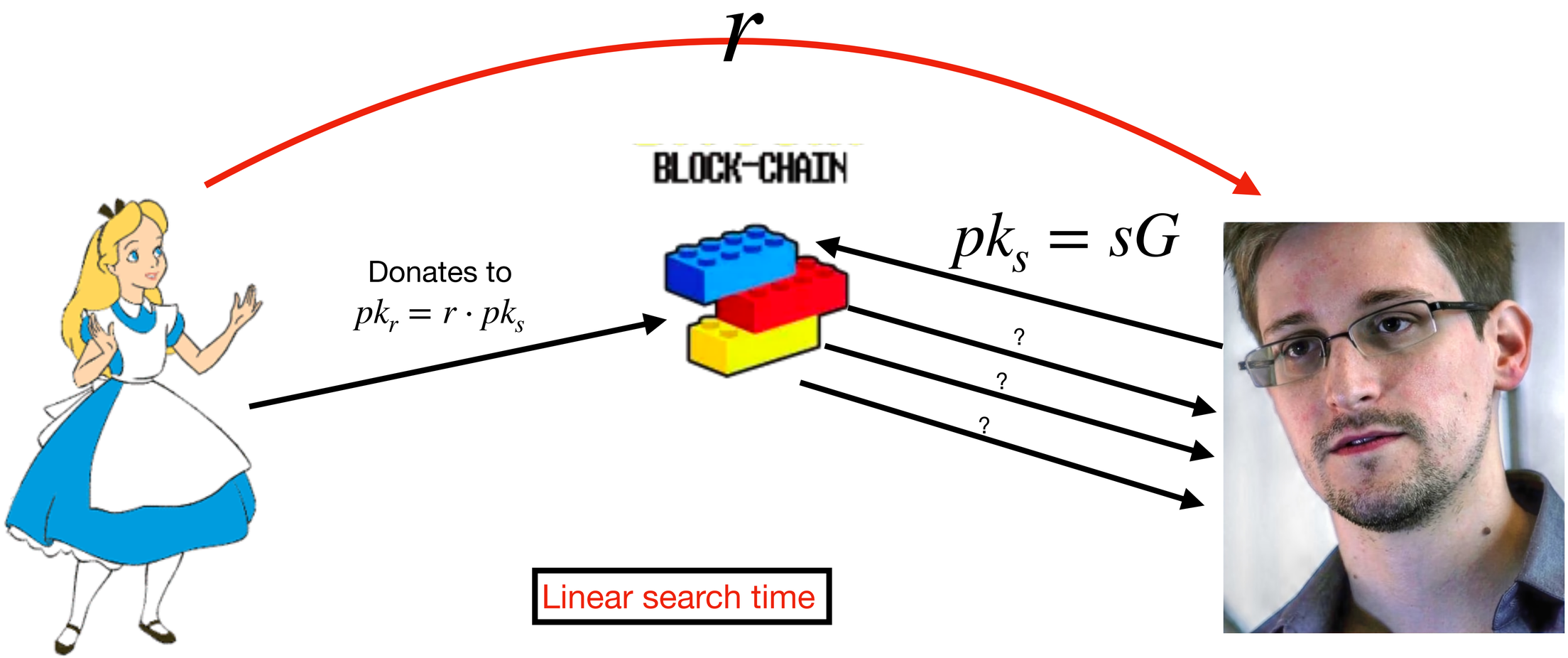
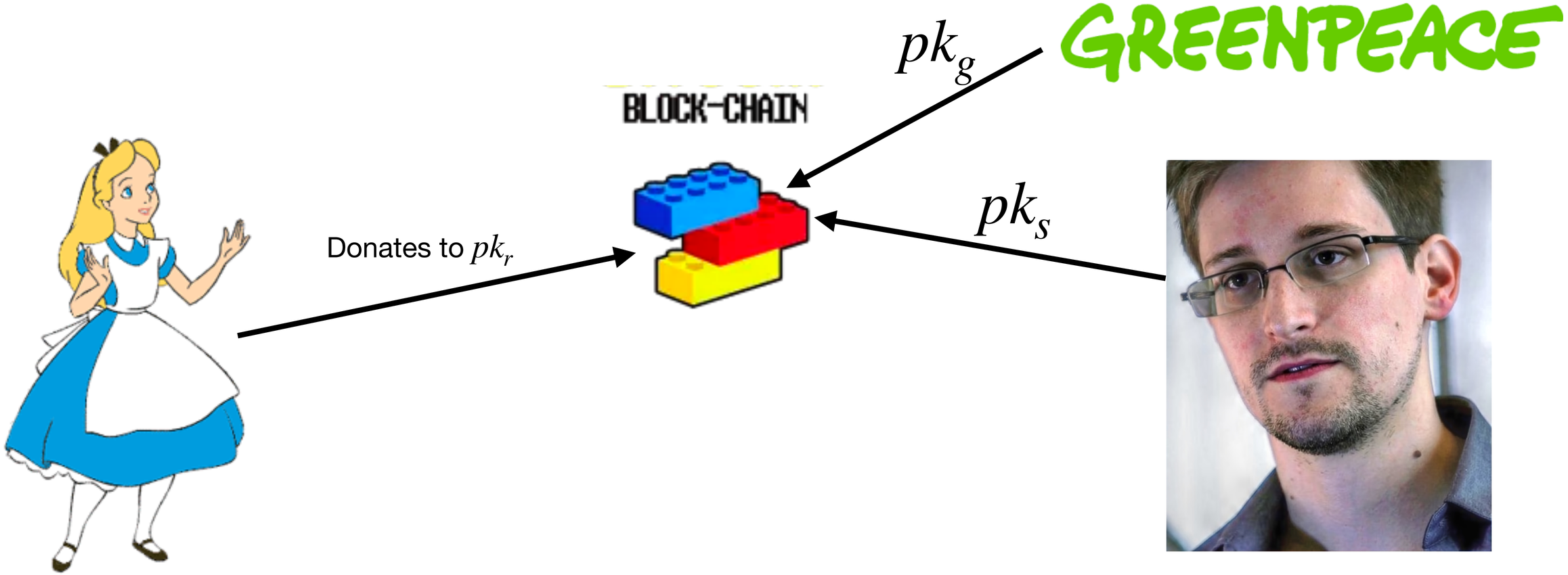


Our solution : FE-PPS



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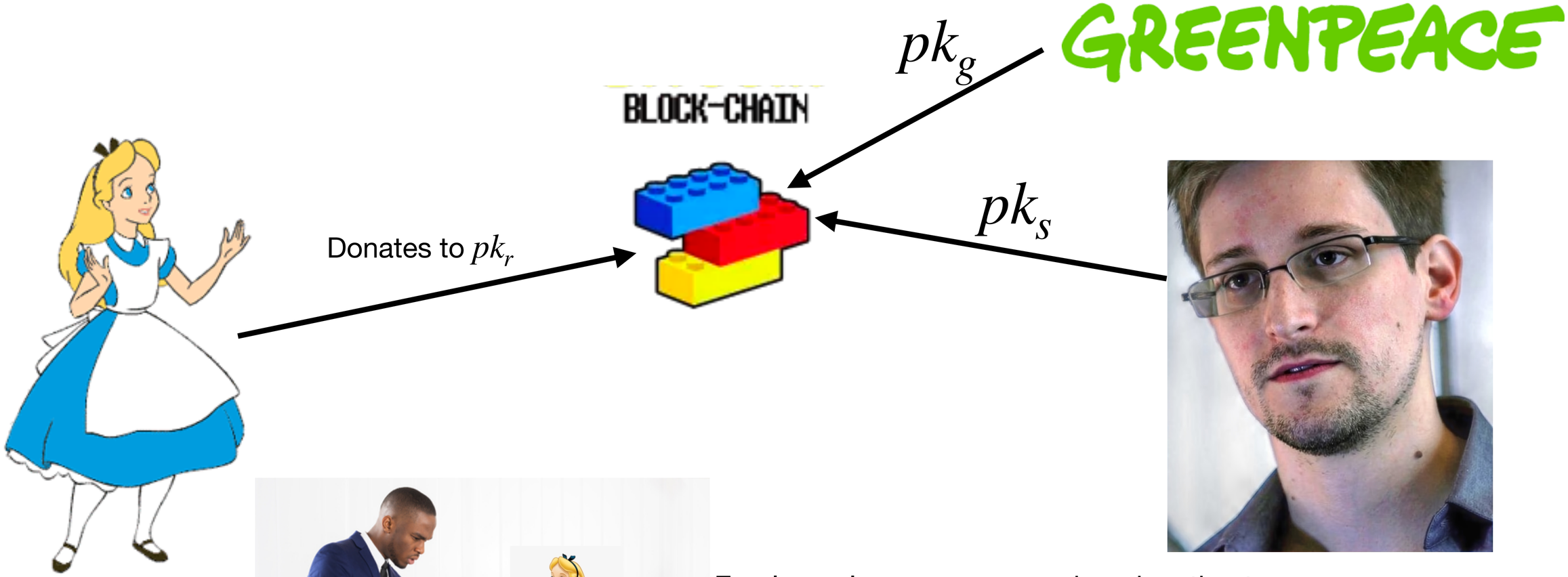
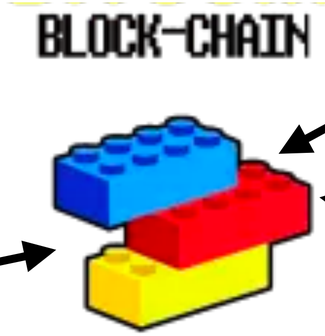


Employer: I can see you made a donation to either Snowden or Greenpeace or xxx or yyy or… very good!

Our solution : FE-PPS

Donates to pk_r



pk_g

GREENPEACE

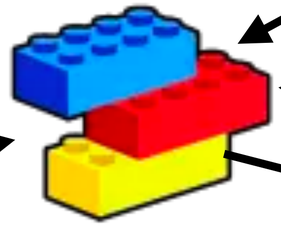
pk_s

Assuming only DDH (no new assumptions!)

Employer: I can see you made “A” donation to either Snowden or Greenpeace or xxx or yyy or… very good!

Our solution : FE-PPS

Donates to pk_r



pk_g

GREENPEACE

pk_s

1. Goes online
2. Detects donation

Search time $= \mathcal{O}(log(t))$, t = number of blocks

Our API

We use simple.DDH (Simple Functional Encryption Schemes for Inner Products)

- **Setup** (assume m receivers)**:**
  - wraps Setup and KeyDer
  - no trusted party is needed
- **Send** (Alice)**:**
  - Wraps Encrypt
  - Reads state from the blockchain $(C^{i-1}, E_1^{i-1}, E_2^{i-1}, \ldots E_m^{i-1})$
  - Updates ciphertext state $[C^i, E_1^i, E_2^i, \ldots E_m^i] = [C, E_1, E_2, \ldots, E_m] + [C^{i-1}, E_1^{i-1}, E_2^{i-1}, \ldots E_m^{i-1}]$
  - Publish new state to the blockchain
- **Search** (Snowden)**:**
  - Wraps Decrypt
  - Binary search for first signal in a range of blocks
  - Collect donation, repeat

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Indistinguishability :
- E_i contains a signal
- E_j contains a signal

Future steps

- Write down a smart contract and ship it live
- Explore building it on Bitcoin (ciphertexts are EC points)
- adjust to work as a Mixer (receivers are also senders)
- take advantage of the inner product: enable auditability for designated authorities
- Malicious security: Zk proof of correct update

Thank you!

DEMO