Overview of a PQC proposal: the Picnic signature scheme

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Outline

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The Picnic proposal

Highlights:

- A signature scheme (KeyGen, sign, verify)
- No number theoretic or structured hardness assumptions
- Security reduction to symmetric primitives (hash, block-cipher)
- Construction based on a ZKPoK
- Ingredients: Σ protocol, Fiat-Shamir and Unruh transforms, "MPC in the head"

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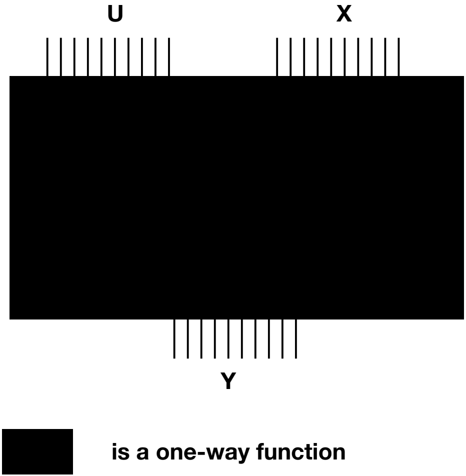
This is a Schnorr signature (I think).

Picnic — illustration at high-level



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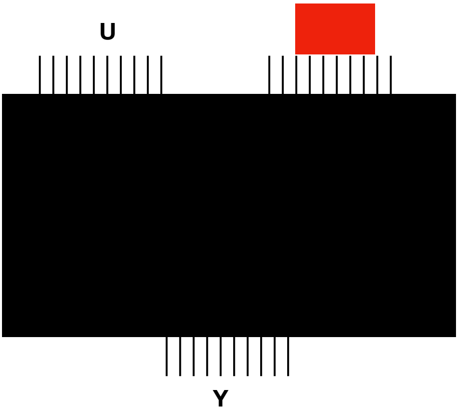

- given U and Y, I claim I know X

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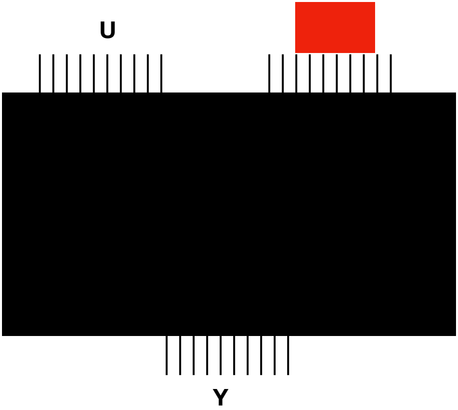

In Picnic :

 **is an encryption function called LOW MC**

Y is the encryption of U under key X

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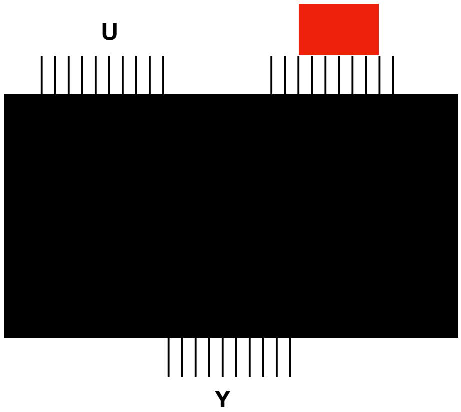

- public key pk is (U,Y)
- private key sk is X

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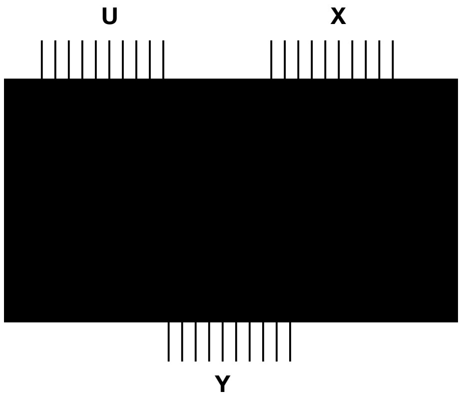

As in Schnorr's signature scheme, we will first need a ZK proof of knowledge of X.

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ON A CIRCUIT FOR LOW MC

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<u>for each output wire:</u> reveal the three shares

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for each gate: propagate the shares from inputs to output

NEXT

for each output wire: reveal the three shares

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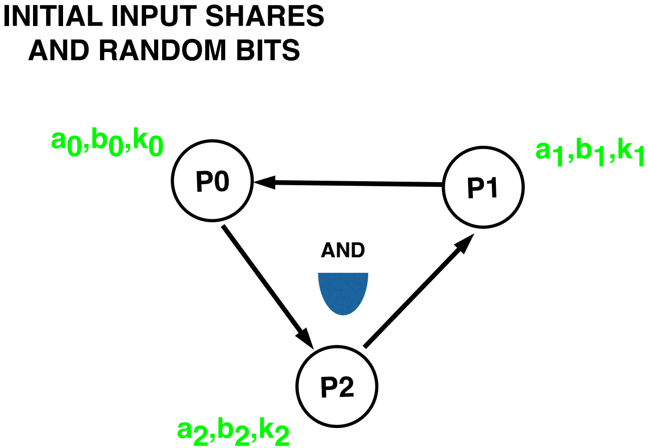

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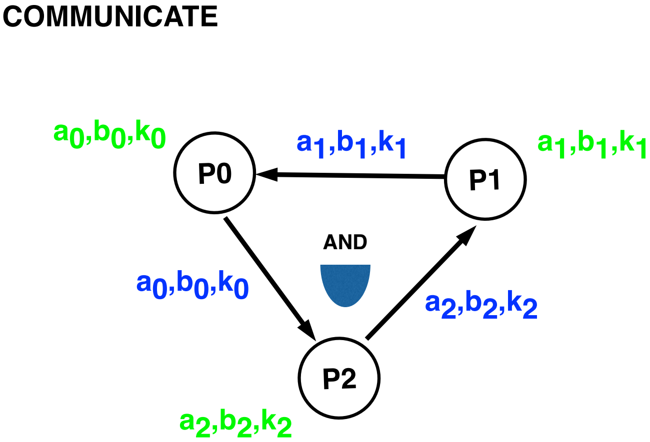

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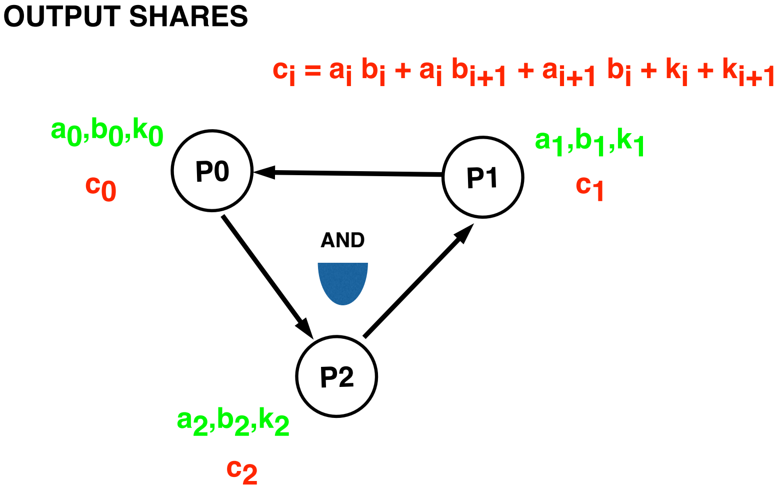

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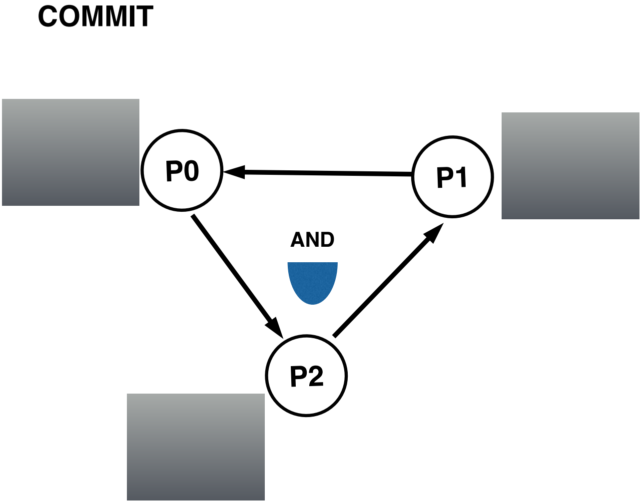

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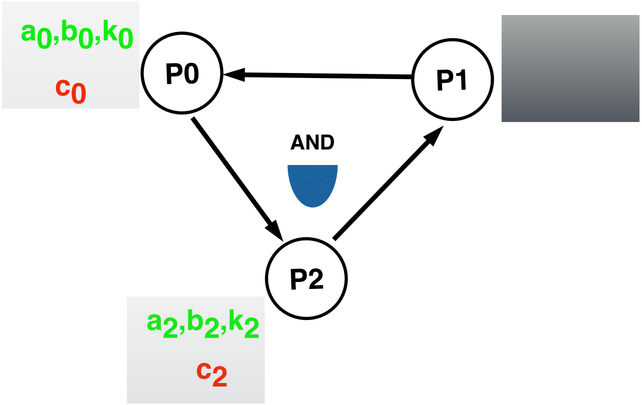
DECOMMIT TWO



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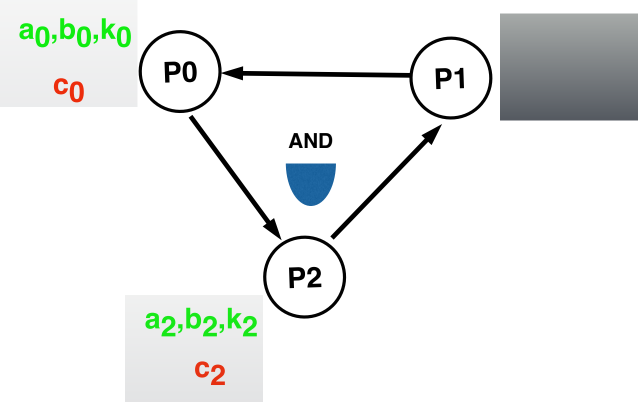
VERIFY

$$c_2 = a_2\, b_2 + a_2\, b_0 + a_0\, b_2 + k_2 + k_0$$



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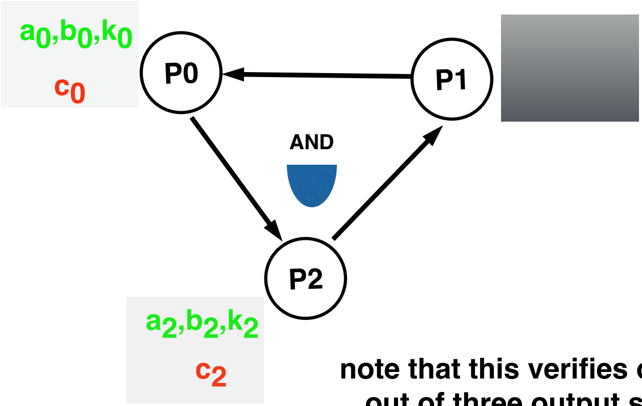

note that this verifies only one out of three output shares

Outline

Primitives and other ingredients

- Commitment schemes
- Zero Knowledge Proofs of knowledge (ZKPoKs)
- Transformation for non-interactivity: Fiat-Shamir, Unruh
- Low-MC and SHA3
- MPC in the head
- PRNG using SHAKE

Parameters

Parameter Set	S	n	k	s	r	Hash/KDF	Digest length	T	Public key	Private key	Signature
`picnic-L1-FS`	128	128	128	10	20	SHAKE128	256	219	32	16	34000
`picnic-L1-UR`									32	16	53929
`picnic-L3-FS`	192	192	192	10	30	SHAKE256	384	329	48	24	76740
`picnic-L3-UR`									48	24	121813
`picnic-L5-FS`	256	256	256	10	38	SHAKE256	512	438	64	32	132824
`picnic-L5-UR`									64	32	209474