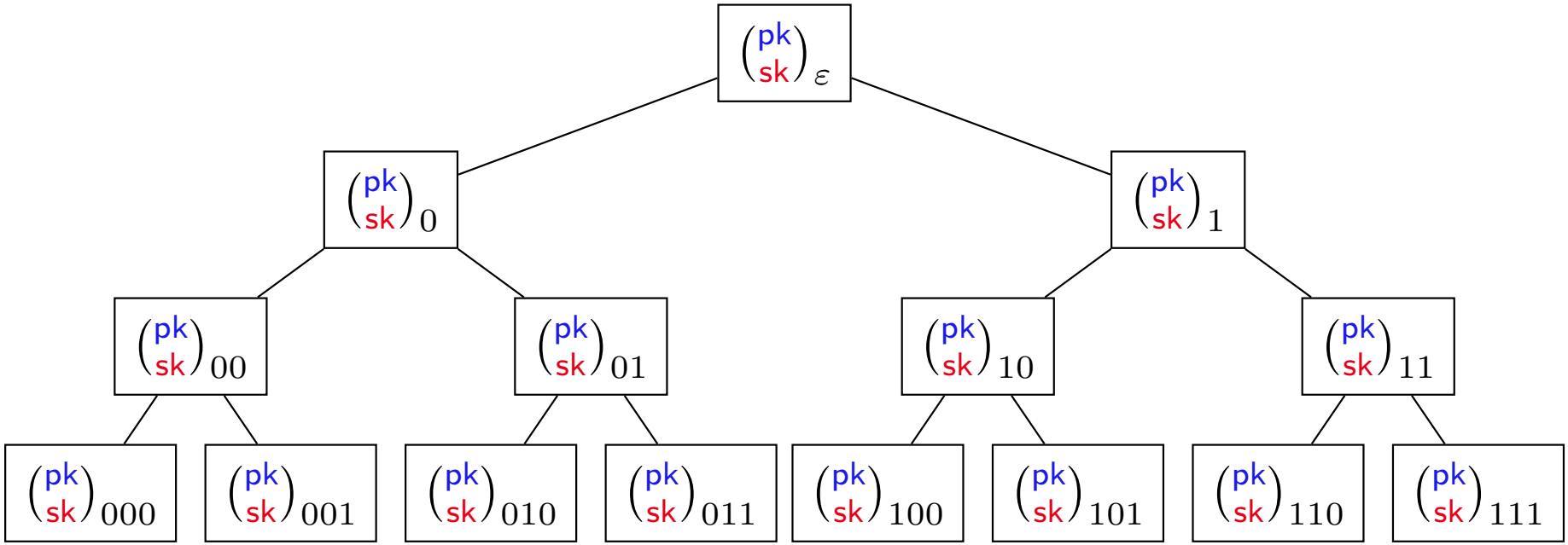
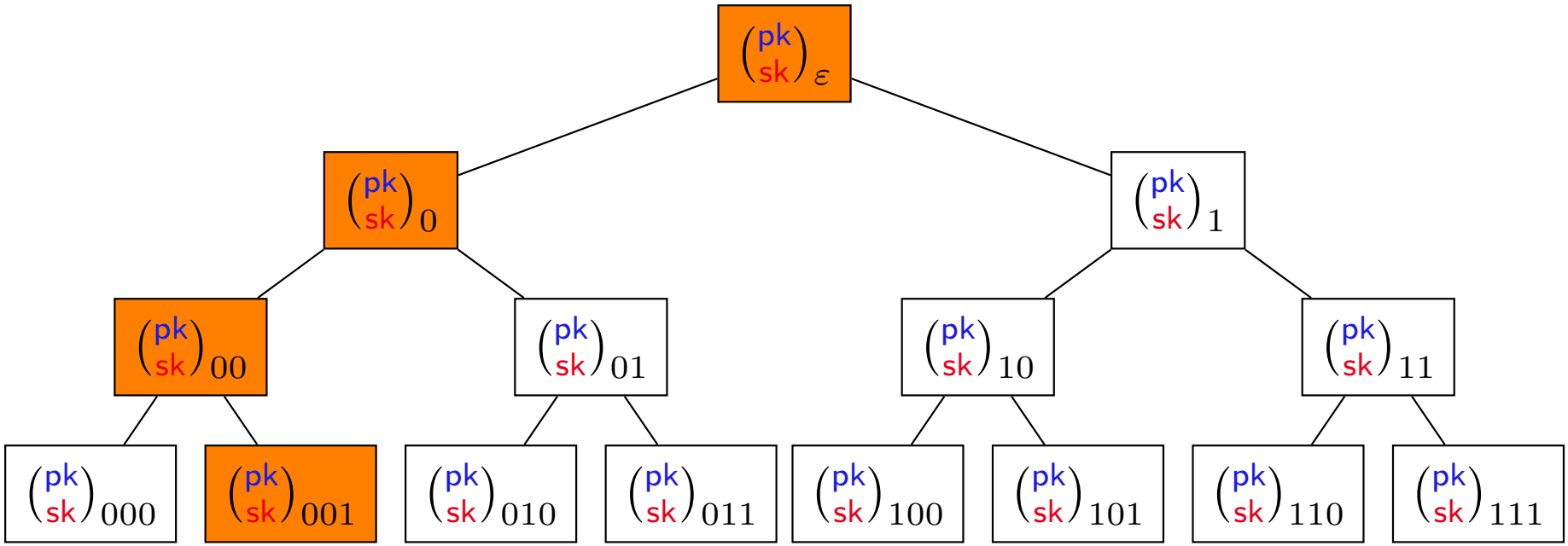
Setup



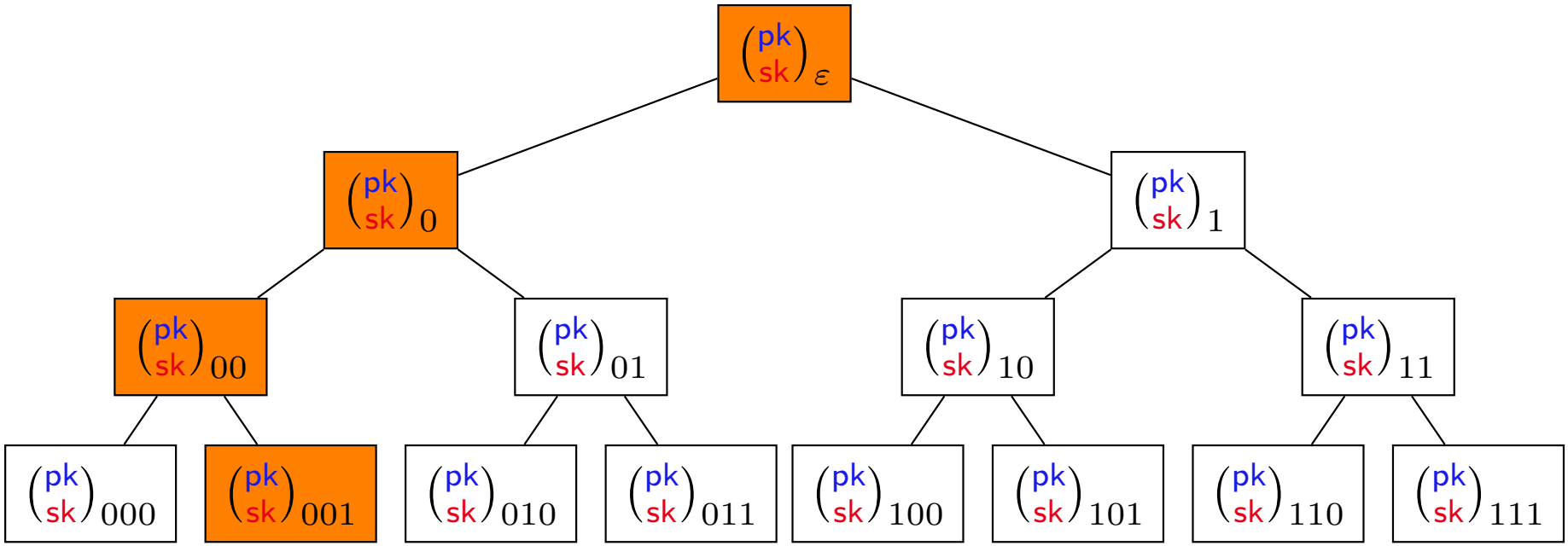
- Full binary tree of depth n
- Nodes at level t are labeled by t-bit strings
- Leaves correspond to messages in $\{0,1\}^n$
- Each node x holds a key-pair $\mathsf{pk}_x, \mathsf{sk}_x$ for OT signature
- Publish pk_ε as the public-key

Signing



$$S'_{\vec{sk}}(001) = \mathsf{pk}_0, \mathsf{pk}_1, S_{\mathsf{sk}_\varepsilon}(\mathsf{pk}_0, \mathsf{pk}_1)$$
$$\mathsf{pk}_{00}, \mathsf{pk}_{01}, S_{\mathsf{sk}_0}(\mathsf{pk}_{00}, \mathsf{pk}_{01})$$
$$\mathsf{pk}_{001}, \mathsf{pk}_{000}, S_{\mathsf{sk}_{00}}(\mathsf{pk}_{000}, \mathsf{pk}_{001})$$
$$S_{\mathsf{sk}_{001}}(001)$$

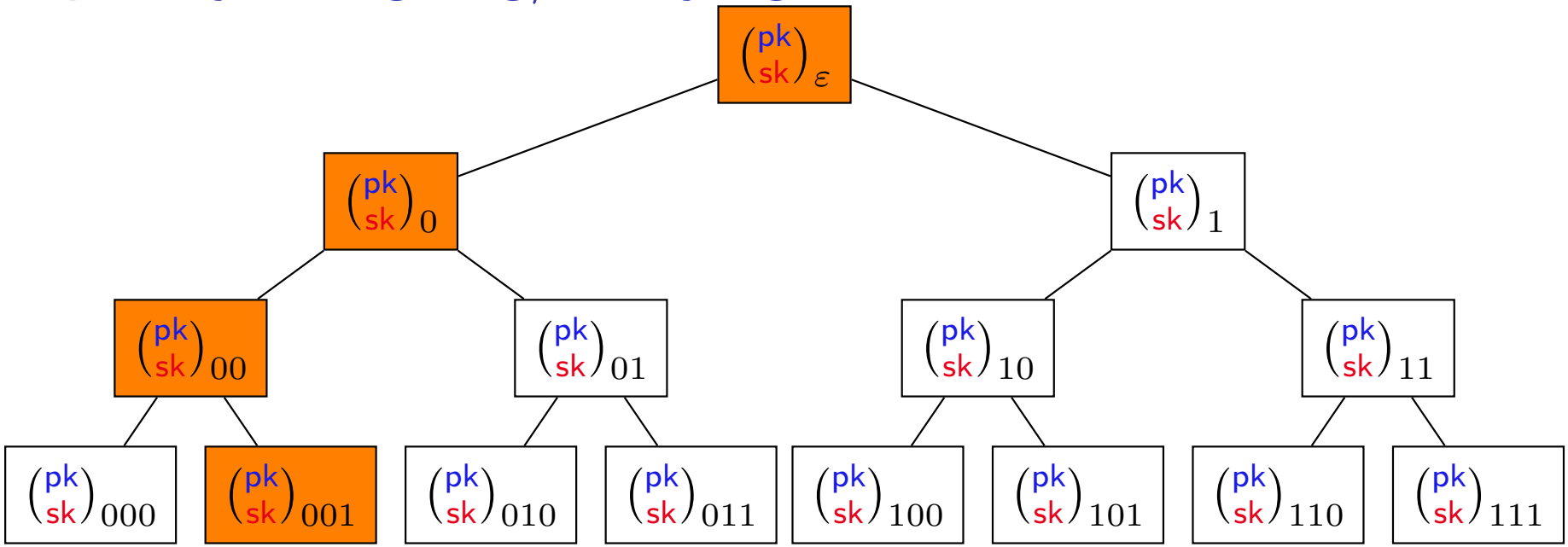
Security



Observations:

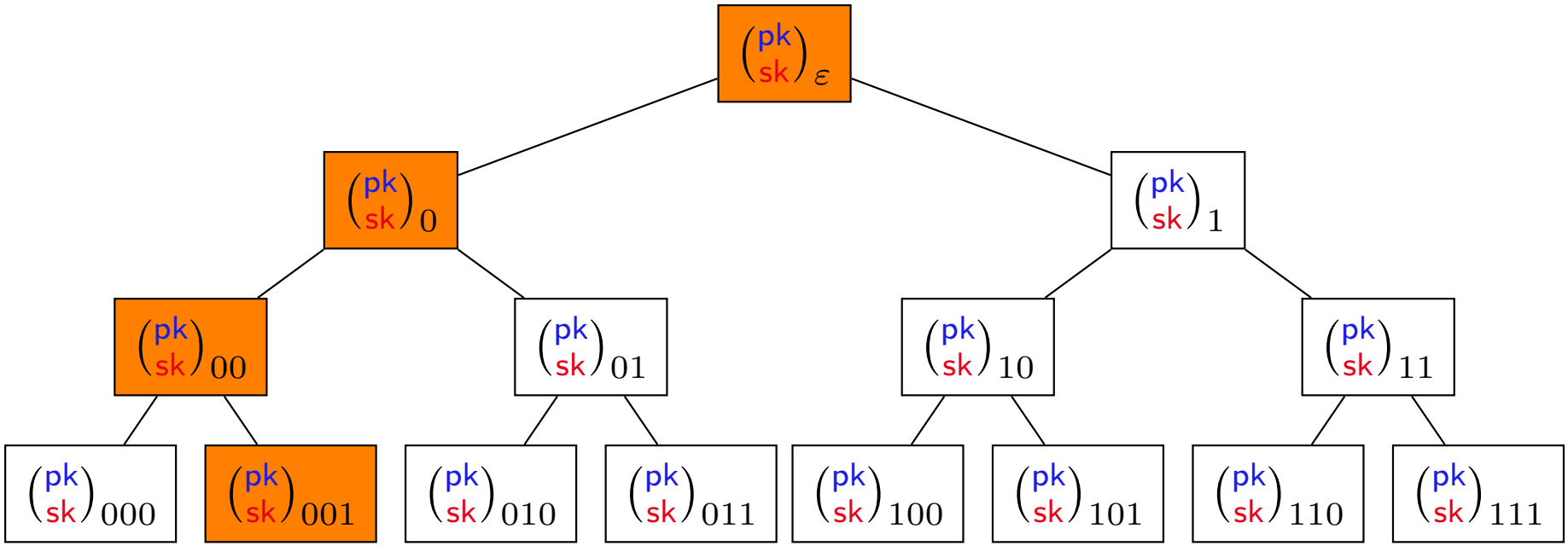
- Each key is used once (for its children)
- new document is always signed by at least one new key

Complexity of signing/verifying



- Signing: walk along the path from root to leaf x, and let each parent (one-time) sign on its children
- Verification is done in the natural way
- Complexity $O(n)$ applications of the one-time signature
- Longer messages can be hashed down to n-bit
- So complexity does not grow with the number of messages :)

Complexity of key-generation



Problem: key of exponential length!

- Sol 1: Generate keys on the fly
- Warning: This must be done in a consistent way! (why?)
- Sol 2: Use pseudorandom function F_k and let $(\mathsf{pk}_x, \mathsf{sk}_x) := F_k(x)$ where k is the global secret key.

Take-Home Message

Some constructions are quite complicated and require several clever ideas

Although the resulting construction is impractical it contains several concepts which are widely used in practice

- Hash and Sign
- Key-Refreshing
- Chain of trust
- Use of pseudorandom function to reduce state