FLEXIBLE SIGNATURES:
Authentication for Real-Time Environments

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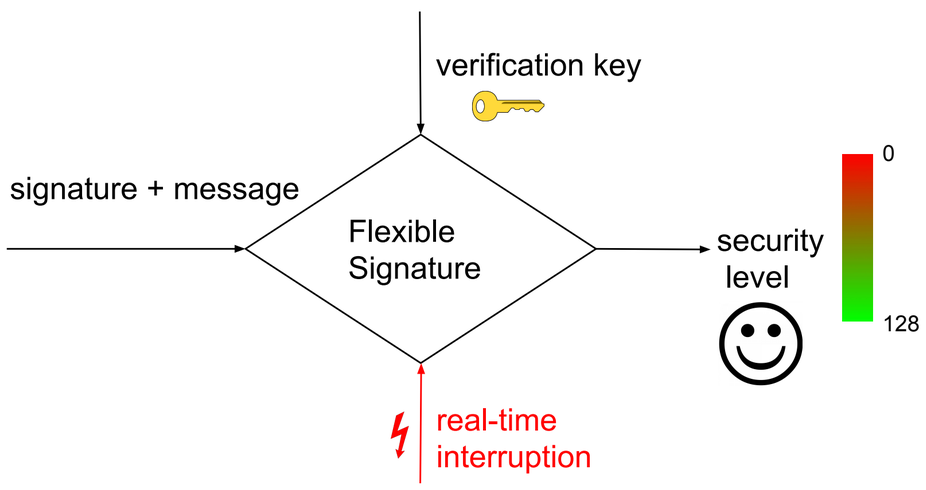
1. PROBLEM AND OVERVIEW

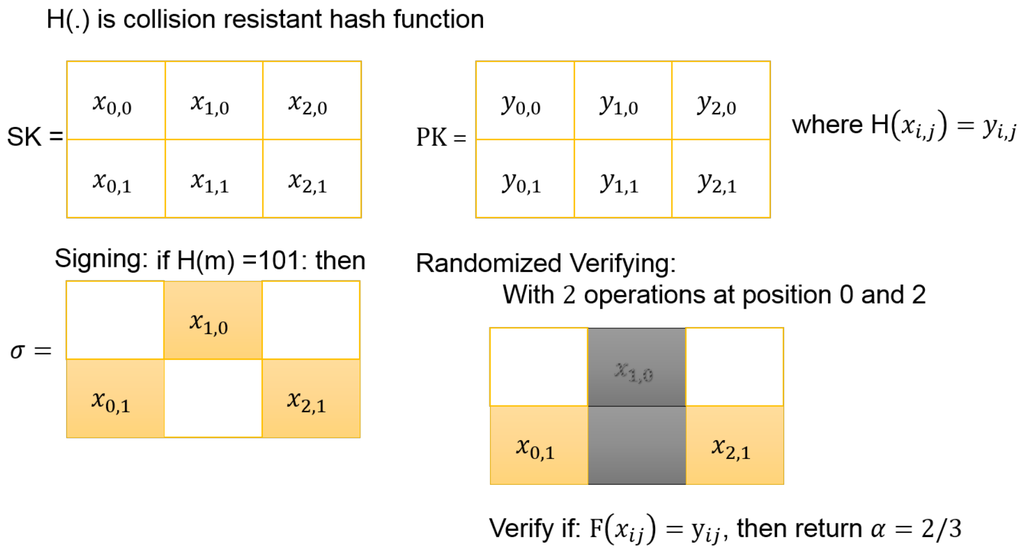
Overview:
- Traditional signature schemes are not designed for uncertain settings with unpredictable resource constraints.
- Can one design a signature scheme that quantifies the validity of the signature based on a fraction of the number of computations performed during the verification?



Proposed Solution: Use Hash-based Digital Signature Schemes like Lamport-Diffie One-Time-Signature and Merkle Authentication Tree. The confidence level is determined by the number of computations passed during verification.

2. FLEXIBLE LAMPORT-DIFFIE SIGNATURE

Idea: Randomly verify different positions of the signature. The more the number of computations passed, the more confident one can be about the validity of the signature.

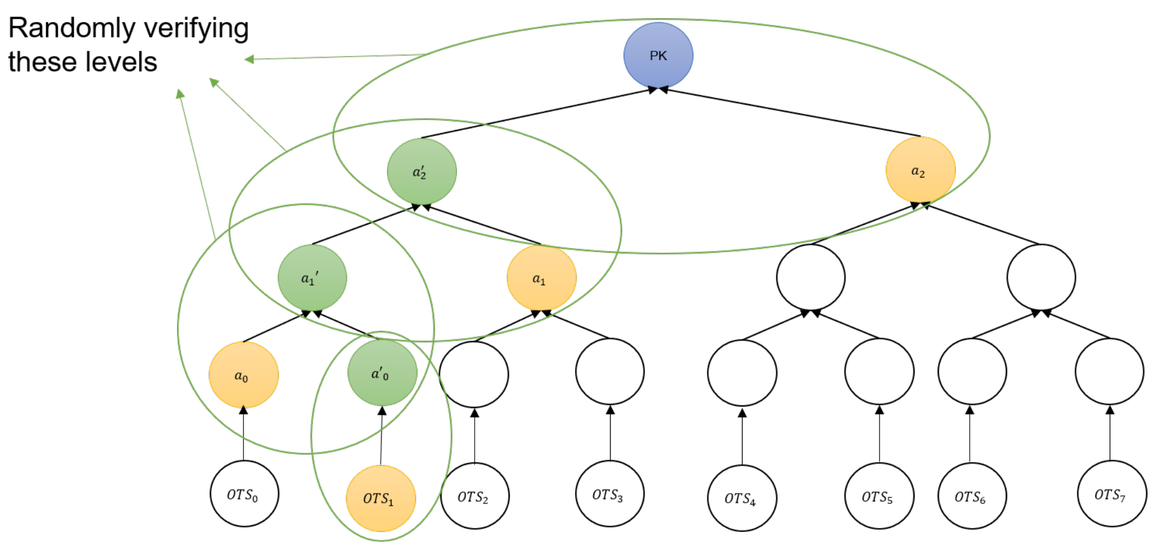


Security: Security of the scheme relies on the problem of finding an ℓ-near-colision pair. Thus, for a smaller ℓ (e.g more computations performed on the signature), more effort is required for attacker to forge the signature.

3. FLEXIBLE MERKLE SIGNATURE

Idea:
Use Merkle authentication tree to convert one-time signature scheme to a many-time signature scheme.

New Signing and Verifying Algorithms:
Require signer to send more authentication nodes. Verifier can verify authenticity of Public key on different levels of the tree. By doing this, the confidence for the authenticity of the one-time public key increases linearly.

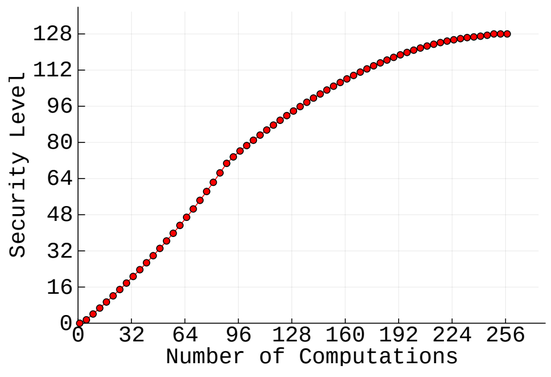


New signing and verification for Merkle Authentication Tree

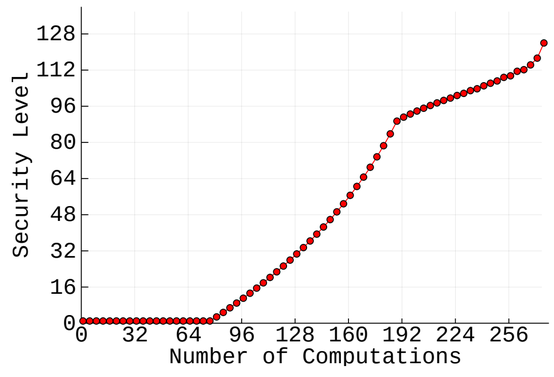
4. EVALUATION

To evaluate both schemes, we constructed a Merkle signature scheme of height h=20 using SHA256, and compared the results for the number of computations k = 32,64,128,192,max where max is the number of computations needed for a complete verification.

Security Level:



Flexible Lamport Signature



Flexible Merkle Signature

Performance:

	$n = 256$				
k	32	64	128	192	max
Lamport-Diffie Signature	0.113 ms	0.162 ms	0.242 ms	0.358 ms	0.425 ms
Merkle signature, $h = 20$	0.510 ms	0.662 ms	0.94 ms	1.10 ms	1.39 ms